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(19) (CA) **CANADIAN PATENT** (12)

(54) Electronic Postage Meter Having Non-Volatile Memory  
Selection Means

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ELECTRONIC POSTAGE METER HAVING NONVOLATILE  
MEMORY SELECTION MEANS

Abstract

An electronic postage meter having an improved memory selection circuit is disclosed. A custom memory map decoder circuit with resolution down to a single byte location is used to provide selection enabling signals to insure the selection of an appropriate device only when the addresses appropriate to that device are communicated. In accordance with the invention, at least two nonvolatile memories are provided. Writing to either of these nonvolatile memories is inhibited unless one and only one memory is selected. The circuit also prevents the selection of either of the nonvolatile memories in the event that the write strobe signal to the memories is held active.

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ELECTRONIC POSTAGE METER HAVING A NONVOLATILE  
MEMORY SELECTION MEANS

The invention relates to postage meters and in particular to electronic postage meters having microcomputer control of printing and accounting functions.

Devices of this type are generally known, and are discussed for example in U.S. Patent No. 3,978,457. This patent discloses a system for a postage meter which includes a keyboard for the manual introduction of data corresponding to the postage to be printed in a Random Access Memory for real time operation. Data is stored in a nonvolatile memory upon power down and read into the Random Access Memory upon power up.

U.S. Patent No. 4,481,604 describes an electronic postage meter having a redundant memory system in which for each postal printing operation identical data is stored, respectively, in two separate but identical CMOS battery-backed nonvolatile memories.

In these known devices, there have been found to be times when essential data has not properly been stored in the nonvolatile memory of the meter. It has been found that one reason might be the improper selection of access to a particular device.

In known electronic postage meters, the microprocessor high order address bits or combination thereof are utilized in a standard decoder for selecting or enabling a particular



memory or peripheral device to be accessed in accordance with the microcomputer instructions. While this normally works well, in many cases of improper operation of the microcomputer or failure of one of the address lines of the bus, an improper bit may be decoded and the select logic gate which then enables the wrong device may cause wrong data to be read from memory or in the worst case cause data to be written into an unknown memory or peripheral with no indication of any malfunction. When this happens there is a strong possibility of service personnel's not being able to recover essential information from the nonvolatile memory in the postage meter when the postage meter fails.

In accordance with the invention, at least two nonvolatile memories are provided. In order to assure that data is written only to a selected nonvolatile memory, a logic circuit is provided which will decode the addresses called by the microprocessor to select one of these

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Nonvolatile Memories and which will enable a write strobe signal from the microprocessor to communicate with the NVM only when one and only one memory is selected. The logic circuit also includes means for preventing the selection of either of the nonvolatile memories in the event that the write-strobe signal is held active.

It is accordingly an object of an aspect of the invention to provide a write strobe signal to the nonvolatile memory only when the appropriate addresses are communicated from the microprocessor so as to particularly insure the reading and

writing of the appropriate data into the appropriate location.

It is an object of an aspect of the invention to provide in an electronic postage meter a means for assuring that the  
5 information in nonvolatile memory may be altered only upon further verification that such altering is intended.

It is an object of an aspect of the invention to prevent the writing of information to Nonvolatile Memory under circumstances where such writing would at all times be  
10 enabled due to a malfunction in the Electronic Postage Meter.

An aspect of the invention is as follows:

In a postage meter having a microprocessor for controlling the printing of value and for accounting for the printing of such value and at least two nonvolatile memories for storing  
15 information, said microprocessors being operative to read  
~~information from and write information to said nonvolatile~~  
memories, said microprocessor providing a write strobe signal operative for enabling writing of information into said nonvolatile memories, nonvolatile memory selection  
20 means comprising a logic circuit for selecting one of said nonvolatile memories in accordance with information from the microprocessor, and means for blocking said write strobe signal to said nonvolatile memories when neither of said nonvolatile memories is selected.

Other features and objects of the invention will become apparent in conjunction with the description of the drawing wherein:

FIG. 1 is a block diagram of an electronic postage  
5 meter in accordance with the invention;

FIG. 2 is a block diagram of a specific arrangement of  
a processor interface circuit in accordance with the  
invention;

FIG. 3 is a schematic of a decoder arrangement in  
10 accordance with the invention;

FIG. 4 is a default memory map showing a preferred  
arrangement of memory locations in accordance with the  
invention;

FIG. 5 is an embodiment of a circuit for providing a  
15 plurality of control output signals for NVM access;

FIG. 6 shows a preferred embodiment for providing a  
signal in response to an illegal address selection;

FIG. 7 shows in schematic form a preferred embodiment of a circuit for providing NVM selection;

FIG. 8 shows in schematic form a status and control circuit arrangement;

5 FIG. 9 is a schematic of a circuit for control of interrupts to the system microprocessor;

FIG. 10 is a timing diagram of the events; and FIG. 11 is a timing diagram.

Referring now to FIG. 1 which is a block 10 diagram of a meter in which the invention may be incorporated. Such meters are known and are described for instance in U.S. Patent No. 3,978,457 to Check, et al and assigned to the assignee of the present invention. In this patent, the working memory under 15 control of the CPU is a Random Access Memory from which data must be transferred to a nonvolatile memory upon loss or shutdown of power to the meter.

U.S. Patent No. 4,481,604 assigned to Roneo Alcatel discloses an electronic postage meter where the 20 Random Access Memory and the nonvolatile storage memories are combined in battery backed CMOS RAMs which are used both for the real time operation and for long term storage of information in postal registers. EPC Application No. 0 085 385 published August 10, 1983, and 25 assigned to the assignee of the present invention discloses an improved dual non-memory system. It will be appreciated by those skilled in the art that such a ~~device may be combined with the electronic postage meter~~ described in Check and is also suitable for the 30 invention disclosed herein. The decoder arrangement disclosed herein is conveniently used to provide a method and apparatus for further protecting essential postal data in conjunction with the circuit described in Canadian Application Serial No. 503,785 filed on even 35 date herewith entitled POSTAGE METER WITH A NONVOLATILE MEMORY PROTECTION CIRCUIT and assigned to the assignee of the present invention.

Still referring to FIG. 1, the heart of the general functional arrangement of the system is the CPU which is utilized with specific instructions programmed in the Read Only Memory (PM), for the performance of control of the basic meter functions, for the performance of calculations based on any input data and for controlling the flow of data into the various memories.

The system, may operate in accordance with data applied from an appropriate input means "I" or from a communications means "C" such as described for instance in U.S. Patent No. 4,301,507 to Soderberg. The data is fed into the CPU under control of the program in Read Only Memory and at any time during the operation of the system, should the contents of the memory storing the appropriate credit/debit balances or other cumulations in accordance with various features of the system be desired to be displayed, appropriate instructions provided by the input means "I" cause the CPU to access the desired locations in memory which store the information requested.

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The information may be displayed on an output unit "O". As well known, the input and output units may be multiplexed by a suitable multiplex unit "MP" for transferring data to and from the CPU.

FIG. 2 is a block diagram of a specific arrangement of a processor interface circuit in accordance with the invention and comprises an address decoder and associated selection circuitry for the selection and control of various elements of the Electronic Postage Meter. It will be appreciated that the circuit arrangement herein described is preferably embodied in a custom LSI microchip, however, it will be understood that the use of conventional logic components is also contemplated.

Turning now to FIG. 2, the overall block diagram of the circuit is shown generally at 10. The demultiplexer 12 in conventional manner demultiplexes the address/data bus 14 of a microprocessor (not shown in FIG. 2), suitably an 8085 series microprocessor available from the Intel Corporation or an NSC800 series microprocessor available from the National Semiconductor Corporation. The bus 14 communicates with the demultiplexer 12 on communication lines 16 through a conventional transceiver circuit arrangement 18. For best results the ADDRESS LATCH ENABLE (ALE) signal 20 from the microprocessor is "anded" with the microprocessor read strobe signal 22 to provide the latching signal for latching the address information for the demultiplexer 12.

The demultiplexed address information is fed out on lines 24 for use in other parts of the EPM and are internally

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connected at 26 to the decoder section 28. The high order address signals directly from the microprocessor are communicated on lines 30 to the decoder section 26. An external decode signal, EXTDEC, is also input to the decoder section 28.

The decoder section 28 receives and decodes a complete input address received at 26 and 30 to provide select outputs for the various parts of the system. The low order demultiplexed address lines A<sub>0</sub>, A<sub>1</sub> and A<sub>2</sub> are utilized as inputs to control flip-flops 32 along with the microprocessor write strobe WR received at 34 from the microprocessor. As described further below, the control flip-flop section generates four control signals in response to these inputs in addition to a decoder reset signal and other derived signals, i.e. EXT-INTP, a pulse signal generated at the activation of the illegal memory access output pin, and a select signal CTRL-S for the selection of the Control Flip Flop block.

Outputs from the decoder 28 are provided to NVM output control block 36. This control block 36 in accordance with the invention provides a fail-safe NVM device selection. The selection of either NVM is disabled if the NVM write line is shorted to the "active" state. The NVM write strobe is disabled whenever the other devices are selected or in the event that both NVMs are simultaneously selected.

In accordance with the invention, an illegal address control block 38, in conjunction with the decoder 28 detects when the microprocessor read or write strobes attempt to access addresses an illegal, i.e. unused, memory space and,

as discussed below, provides a signal output for interrupting the processor.

Status and control block 40 monitors the outputs from the control Flip-Flop section and provides a control port to generate a decoder reset and to control the selection of an internal or external communication through an "Echoplex" I/O section 42. Preferably the section also includes an 8-bit timer to set the Transmit Baud rate for the serial communications.

Dual Timer section 44 provides two programmable 16-bit timers. Preferably the system clock is the clock input to the timers. Suitably each is programmable for continuous or for one-shot operation for generating an interrupt when the programmed count is completed. Conveniently an 8-bit counter divider can be selected to prescale the clock input or the ripple output of the first timer may be selected as the clock input to the second timer.

Conveniently serial I/O block 46 and parallel I/O block 48 are utilized for communication with a keyboard and display and for motor control, sensing postal value and miscellaneous control functions.

For best results, an Interrupt Status and Control Block 50 is provided along with an interrupt mask control port for enabling selected interrupts to interrupt the systems processor.

FIG. 3 shows a schematic of an embodiment of a decoder block for providing a decoded memory map in accordance with the invention. The crossed lines with a circle superposed

are used to indicate the preferred conductive path in a customized chip arrangement. It will be appreciated that the illustrated arrangement is extremely convenient in that the decoded memory map as described below may be modified easily with only a few mask changes.

The various addresses communicated in known manner from the microprocessor and demultiplexer as described previously are each fed to leads A1 through A15 of the decoder block 28. The address bits on address lines A11 through A15 are supplied to NAND gates 52, 54, 56, 58, and 60 and inverted at inverters 62, 64, 66, 68, and 70 and applied as illustrated to the NAND gates 52, 54, 56, and 58. An external decode signal 72 (see also FIG. 2) is applied to NAND gate 60. The output of NAND gate 60 is NOR'D with the outputs of gates 52, 54, and 56. The EXTDEC signal is also applied directed to gate 58. It will be noted that when "active" this signal will disable the decode function. The decoded outputs from the connections illustrated in FIG. 3 for the preferred embodiment are as shown in Table I and in

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FIG. 4.

TABLE I

OUTPUTS

ROM#	: SELECT FOR EXTERNAL PROM MEMORY
RAM#	: SELECT FOR EXTERNAL RAM MEMORY
SEL1	: FOR GENERATING THE SELECT FOR EXTERNAL NVM#1
SEL2	: FOR GENERATING THE SELECT FOR EXTERNAL NVM#2
CNTRL-S\	: SELECT FOR INTERNAL CONTROL FLIP-FLOP BLOCK
INTR-S\	: SELECT FOR INTERNAL INTERRUPT CONTROLLER
STAT-S\	: SELECT FOR INTERNAL STATUS BLOCK
TIMER-S\	: SELECT FOR INTERNAL DUAL-TIMER BLOCK
ECHO-S\	: SELECT FOR INTERNAL ECHOPLEX BLOCK
SERIAL-S\	: SELECT FOR INTERNAL SERIAL I/O BLOCK
PARALLEL-S\	: SELECT FOR INTERNAL PARALLEL I/O BLOCK
ECHO/VOID#\	: SELECT FOR EXTERNAL ECHOPLEX BLOCK OR SPARE DECODE SIGNAL WHEN UNUSED MEMORY SPACE IS SELECTED (OR NEITHER)
IO\	: ACTIVE WHEN ANY I/O SELECTS ARE ACTIVE
IOREAD\	: ACTIVE WHEN ANY OF THE INTERNAL SELECTS ARE ACTIVE
DVOID	: ACTIVE WHEN "ExtDec\" IS INACTIVE AND WHEN NONE OF THE SELECT OUTPUTS ARE ACTIVE

<u>OUTPUT SIGNAL</u>	<u>ADDRESS RANGE(S)</u>	<u>SIZE</u>
ROM#	0000 - 7FFF	32 KBYTES
RAM#	C000 - C7FF	2 KBYTES
SEL1	D000 - D7FF	2 KBYTES
SEL2	E000 - E7FF	2 KBYTES
ECHO-S\	FFD8 - FFDF	8 BYTES
STAT-S\	FFE0 - FFE1	2 BYTES
INTR-S\	FFE2 - FFE7	6 BYTES
PARALLEL-S\	FFE8 - FFEB	4 BYTES
SERIAL-S\	FFEC - FFEE	4 BYTES
TIMER-S\	FFF0 - FFFF	8 BYTES
CNTRL-S\	FFF8 - FFFF	8 BYTES
IO\	FFD8 - FFFF	48 BYTES
IOREAD\	FFD8 - FFFF; IF "EXTECHO\" INACTIVE FFE0 - FFFF; IF "EXTECHO\" ACTIVE	

It will be noted that in accordance with the invention, an active DVOID output is provided from NAND gate 74 when none of the system's blocks are selected. It will also be clear to one skilled in the art that the address bits, when appropriately decoded as in the illustrated circuit by NAND gates 76, 78, 80, 82, 84, and 86 and inverters 88, 90,

92, 94, and 96 provide an "active" output I/O whenever any of the I/O functions is selected and an "active" I/O read output whenever any of the internal circuit functional blocks are selected. Address bits A3 and A4 are applied to 2-to-4 demultiplexer 98 and decoded with other low order address bits for providing output signals as defined in Table I for selecting the appropriate blocks.

It will be understood that the signal DVOID is not necessarily limited to its previously described function. For instance, in the illustrated embodiment, a signal VINT from the control flip-flop block further described below may be used to convert this DVOID signal to another decode output. This signal shown as "ECHO/VOID" in FIG. 3 is available if the circuits internal ECHOPLEX block 42 is utilized. Alternatively it will be seen that if an external "echoplex" section is utilized, that is, when the signal "EXTECHO" is "active" the "ECHO/VOID#" output becomes the "select" signal for the external block and the "select" signal for the internal echoplex section, "ECHO-S" is disabled.

As mentioned previously, the Control Flip-Flop section 32, more particularly shown in FIG. 5, generates four control output signals and their complements for controlling the generation of an illegal address interrupt signal to the processor, to provide an independent enable/disable for the access to two separate NVM storage devices, to enable and disable meter postage printing and access to nonvolatile storage.

As best seen in FIG. 5 the low order address signals A<sub>0</sub>, A<sub>1</sub>, and A<sub>2</sub> are fed to a 3-to-8 Line Decoder Multiplexer 102 equivalent to a 74HC138 available from RCA to set and reset flip-flops 104, 106, 108, and 110. The processor strobe signal WR and the select signal CNTRL-S are applied to the enable inputs of decoder 102. As illustrated, it is apparent that the control flip-flops are selectively controlled when both these signals are "active".

The decoder reset signal RST and EXT-INTP (a pulse signal generated at the activation of the illegal memory access interrupt signal) are "NAND'D" at "NAND" gate 112, inverted at inverter and applied to each of the flip-flops 104 and 110. Table II shows the preferred decoded control signals in response to the appropriate addresses.

TABLE II

<u>A<sub>0</sub>-2</u>	<u>DECODED CNTRL</u>	<u>FLIP-FLOP</u>	<u>OUTPUT</u>	
0	VINT-CLR\	VINT	INACTIVE	
1	VINT-EN\	VINT	ACTIVE	PRESET
2	WR2-RESET\	WR2-EN	INACTIVE	PRESET
3	WR2-SET\	WR2-EN	ACTIVE	
4	WR1-RESET\	WR1-EN	INACTIVE	PRESET
5	WR1-SET\	WR1-EN	ACTIVE	
6	UNLOCK-SET\	UNLOCK	ACTIVE	
7	UNLOCK-CLR\	UNLOCK	INACTIVE	PRESET

The outputs from flip-flop 104 designated UNLOCK are preferably active to enable postage printing and for NVM access. For best results, the preset value is inactive to prevent printing and NVM access. The signal WR1-EN and WR2-EN are "active" for write access to respective NVM devices #1

and #2. Again, for best results the preset values are "inactive".

The output VINT which as previously discussed is fed to the decoder section 28 is active to enable an interrupt generation whenever an illegal memory access is attempted. It will be appreciated that this is preferred since in the "inactive" state it may be used to reset the generated interrupt signal or to disable the interrupt so that it may be used as a spare decode output. The VINT preset signal is "active" to enable the interrupt.

The illegal address control block 38 is shown more particularly in FIG. 6. This circuit is used to provide an indication of when access to unused memory space is attempted.

The DVOID decoded signal output from the decoder section 28 is nanded at NAND gate 106 with the Q output from a D Flip-Flop 108. The processors read strobe RD and write strobe WR are NAND'D at NAND gate 110, inverted and applied to the clock input of the D flip-flop 108. The decoder reset signal is NANDED with the "VINT" signal from the control flip-flop section 32 at NAND gate 112 and applied to the RESET input shown as CLR in the Figure.

Thus, depending upon the status of the signal VINT as discussed previously, the decoded void memory space indication will be latched at the lead edge of either the read or the write strobe of the microprocessor to provide the output INT-VOID from the Q terminal of flip-flop 108. In accordance with the invention, the INT-VOID signal is

provided to the system microprocessor as an interrupt signal. Preferably this indication will remain latched until reset by the reset signal from the microprocessor.

Conveniently as seen in FIG. 2 the output is inverted at inverter 116 and supplied at 118 at INT-VOID.

For best results, this INT-VOID output pin in open-drain so as to permit any of a number of open-drain outputs wire-ored to this pin to activate the output signal. This output pin is then suitably tapped as the input signal EXT-INT which is furnished to the Status and Control Block. There, this signal is provided as a status port bit and upon its actuation, a 1 clock period pulse is generated on signal EXT-INTP. This EXT-INTP is provided from the status and control section to reset the control flip-flop and parallel I/O sections to their default (safe) states when the INT-VOID output pin is activated.

Turning now the FIG. 7, the NVM Output Control Block 36 is shown in greater detail. In order to insure secure accounting in the NVM the WRITE access to the two independent NVM devices is independently enabled and disabled under software control.

The NVM OUTPUT CONTROL will block the microprocessor write strobe WR unless either of the NVM decoded select signals SEL1 and SEL2 is available and the appropriate write enable signal from the control flip-flops are available at NAND gates 118 and 120. The output of these gates are inputs to NAND gate 122 whose output is applied to NAND gate 124.

The output of this gate is inverted and supplied to NAND gate 126.

The other signals applied to NAND gate 124 are the decoded select signals NVM1, NVM2, ROM, RAM and VOID are taken from the output drivers and applied to NAND gate 124, with NVM 1 and NVM2 being NOR'D at NOR gate 128 and inverted before being applied to 124. It will be appreciated that the write strobe WR is blocked if the appropriate memory space is not selected. It will also be appreciated that if both NVMs are selected simultaneously the write strobe will also be blocked.

A further protection feature is provided in the event that the NVM write strobe output is shorted "active". The address enable strobe at 20 is applied as the clock signal to a D flip-flop 130. If the NVMWR is shorted active, the ALE signal clocks the Q output low to block both of the NVM device selection signals at NAND gates 132 and 134.

FIG. 8 is a schematic of the status and control block.

The block comprises a status port to allow monitoring of the control flip-flop outputs. The outputs of the control flip-flop block 32 are applied to buffer 136 for output to data bus 138, see also FIG. 2. The system clock input from 140 (see FIG. 2) is used in conventional fashion for timing the internal reset output by counting through D flip-flops 142, 144, and 146 to provide signal IRST which is the control signal for resetting all of the flip-flops in the circuit and is applied along with the System Reset to AND gate 148, (see FIG. 2).

The block select signal STAT-S for this block, the write strobe, read strobe, and lowest order address bit are decoded to clock the writing of data at octal flip-flop 150, for initiating a general decoder reset under the control of appropriate software commands and for setting a baud-rate divider circuit if desired. The EXTECHO signal from D flip-flop 152 is used as previously discussed for selection of an external communication device (not shown).

The Interrupt Controller block 50 is shown in more detail in FIG. 9. The interrupt controller in accordance with the invention provides great flexibility in the servicing of the various interrupt signals to the microprocessor. The signal INT-VOID from the illegal address control block 38, signals INT-TO and INT-TI generated by the time-out of timers in timer block 44, signal INT-ECHO from the ECHOPLEX block 42 which is "active" to indicate the start of an echoplex message, signal INT-SERIAL from serial I/O block 46 which is "active" when new data is received or when ~~the port is read for sending data, and signal INT-MOTOR from~~ PARALLEL I/O block 48 which is preferably "active" when an illegal motor control output has been communicated are each input to the INTERRUPT CONTROLLER block 50. The status of each of these signals may be read out directly from buffer 154 when the RD-INTR signal is "active".

Signal INTA from the system microprocessor is an interrupt acknowledge. It will be appreciated that if the INTA line is held or tied in the "inactive" state, each interrupt signal input applied through gates indicated

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generally at 156 and fed to NAND gate 158 will create an interrupt request signal INTR for communication to the system's microprocessor. Preferably, mask bits may be fed as data on data input bus 16 for providing masking bits to D-flip-flops 160 for latching. The latched outputs from 160 are applied to gates 156 so that the interrupt request will be generated whenever an unmasked device requests service. The particular device requesting service may be determined by reading the status buffer 154. The interrupt lines are also coded at the gates indicated generally at 162 for feeding to latch 164 which also provides similar information.

Preferably, as shown, there is also included a vectored interrupt for the handling of service requests. As discussed previously, a non-masked interrupt results in the generation of an interrupt-request signal to the systems microprocessor. For best results, the microprocessor upon receiving this signal will transmit an interrupt acknowledge signal INTA. This signal places the contents of the opcode latch 166 onto the data bus. In accordance with the invention, the processor interprets this data as an opcode, normally a call instruction for the microprocessor. Upon execution of the instruction, the microprocessor generates another INTA pulse to enable the lower vector latch 168. The encoding of bits on this latch as described above. The vector thus generated, desirably reflects a predetermined code representing the highest priority interrupt. The next INTA pulse, in response to the call of this OPCODE, will

place the data residing in latch 170, preferably the upper vector address data, onto the data bus 138.

The INTR-S signal is utilized to select this block. The low order address signals A0 through A2 are used as illustrated to decode the various control signals on the gates indicated generally at 140.

Echoplex circuits suitable for use in block 42 are discussed in U.S. Patent No. 4,301,507 incorporated by reference herein. Serial I/O and parallel I/O port circuits are well known and will not be discussed further herein.

FIG. 10 and FIG. 11 are timing diagrams showing the interrelationship of signals previously discussed. The designated parameters and preferred timing are shown in TABLE III. It is believed that these diagrams will be readily understood by those skilled in the art so they will not be further described except with regard to the operation of the circuit.

TABLE III

SYMBOL	PARAMETER	MIN	MAX	UNIT	NOTE
$t_{ALE}$	ALE STROBE WIDTH	75		ns	CONDITION
$t_{AHS}$	A8-15 SET-UP TIME	50		ns	CONDITION
$t_{ALS}$	A8B-7 SET-UP TIME	40		ns	CONDITION
$t_{ALH}$	A8B-7 HOLD TIME	30		ns	CONDITION
$t_{ARW}$	ALE TO RD\ OR WR\ STROBE	125		ns	CONDITION
$t_{RDW}$	RD\ STROBE WIDTH	225		ns	CONDITION
$t_{WRW}$	WR\ STROBE WIDTH	220		ns	CONDITION
$t_{WS}$	WRITE DATA SET-UP TIME	50		ns	CONDITION
$t_{INW}$	INTERRUPT PULSE WIDTH	125		ns	
$t_{ACC}$	ALE TO VALID DATA		300	ns	
$t_{ALD}$	ALE TO VALID A8-7		50	ns	$t_{ACC MAX} = 250\text{ns}$
$t_{(CE)PD}$	A8-15 TO :				
	ROM\ ENABLE STROBE		50	ns	$t_{ACC MAX} = 250\text{ns} + t_{AH MIN}$
	RAM\ ENABLE STROBE		50	ns	$t_{ACC MAX} = 250\text{ns} + t_{AH MIN}$
	NVM1\ ENABLE STROBE		60	ns	$t_{ACC MAX} = 280\text{ns} + t_{AH MIN}$
	NVM2\ ENABLE STROBE		60	ns	$t_{ACC MAX} = 280\text{ns} + t_{AH MIN}$
	ECHO/VOID\ STROBE		70	ns	$t_{ACC MAX} = 280\text{ns} + t_{AH MIN}$
$t_{DS}$	INPUT PORT DATA SET-UP TIME		50	ns	
$t_{WH}$	WRITE DATA HOLD TIME	75		ns	
$t_{NWD}$	WR\ TO NVMWR\ DELAY		35	ns	$t_{WH MIN} = t_{NWD MAX}$
$t_{NVMH}$	WRITE DATA HOLD TIME AFTER NVMWR\		50	ns	$t_{WH MIN} = t_{NWD}$
$t_{DO}$	WR\ TO OUTPUT PORT DATA VALID		75	ns	$t_{WH MIN}$
$t_{RH}$	A8-7 HOLD TIME AFTER RD\	0		ns	
$t_{RDH}$	DATA HOLD TIME AFTER RD\	0	50	ns	
$t_{RWI}$	RD\ OR WR\ TO INTR\		90	ns	
$t_{DMLT}$	DM1DIS\ TO A8-7 FLOAT		25	ns	
$t_{EXT}$	EXTDEC\ to CE's FLOAT		25	ns	

The operation of the circuit has been particularly described with respect to each of the functional units. Broadly, however, the circuit 10 in accordance with the invention receives and decodes the periodic address signals communicated from the microprocessor and received at decoder block 28 and control flip-flop block 32. The address signals are decoded to provide an "active" selection signal for each of the various blocks of the circuit 10 and the memory devices of the electronic postage meter depending upon the communication of the appropriate addresses for the particular device. In the event that an illegal address is communicated either because of a microprocessor or software failure or because of a failure in the instant circuit, the DVOID signal from the decoder block 28 goes "active" causing the output of gate 106 (FIG. 6) to go high and latching the Q output of flip-flop 108 active. Thus a latched interrupt signal is sent to the interrupt control block 50 for communication to the microprocessor which responds as previously described above in conjunction with FIG. 9 whenever an illegal access is attempted.

As discussed previously, further protection is provided in the event that both nonvolatile memories are selected. As seen in FIG. 7, if both the NVMI and the NVM2 signals are active the output of gate 128 is high. This output is inverted and applied to gate 124 whose output is then held high so long as both devices are selected. The output of 124 is inverted and the low input to gate 126 blocks the microprocessor's write strobe WR to the NVM. It

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will also be appreciated that an additional interlock exists on the write access to each NVM by way of control flip-flops WR1-EN and WR2-EN. Under software control, write access is provided to NVM1 only when WR1-EN is set. Similarly, write access is provided to NVM2 only when WR2-EN is set.

Protection is also provided during system power up with the use of the unlock control flip-flop signal. It is a master control of access to the NVM's and postage printing which will disable these functions until the software operating system is ready to enable them.

In order to assure that signal NVMWR, the output from gate 126 is not shorted active and so to assure that writing to the NVM is being commanded by the microprocessor, the selection of a nonvolatile memory is blocked if NVMWR is held active. The output write enable signal NVMWR is fed to latch 130 (FIG. 7) which is clocked by the address-latch-enable signal (ALE) from the microprocessor. The Q output from the latch which is normally high is used to enable gates 132 and 134.

If NVMWR is active when the ALE signal becomes active, the Q output of latch 130 goes high and blocks the output of gates 132 and 134. Thus in order for a nonvolatile memory to be selected there must be a periodically active nonvolatile memory write enabling signal and selection of only one nonvolatile memory to assure that the microprocessor is providing the appropriate data to the appropriately selected NVM.

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It will be understood that the claims are intended to cover all changes and modifications of the embodiment herein chosen for the purpose of illustration which do not constitute departures from the scope and spirit of the invention.

What is claimed is:

1. In a postage meter having a microprocessor for controlling the printing of value and for accounting for the printing of such value and at least two nonvolatile memories for storing information, said microprocessor being operative to read information from and write information to said nonvolatile memories, said microprocessor providing a write strobe signal operative for enabling writing of information into said nonvolatile memories, nonvolatile memory selection means comprising a logic circuit for selecting one of said nonvolatile memories in accordance with information from the microprocessor, and means for blocking said write strobe signal to said nonvolatile memories when neither of said nonvolatile memories is selected.
2. The electronic postage meter of claim 1 including means for blocking the write strobe signal whenever both nonvolatile memories are simultaneously selected.
3. The electronic postage meter of claim 1 further comprising means for preventing the selection of either of said nonvolatile memories in the event that the write strobe signal communicated to said nonvolatile memories is held in an active state.

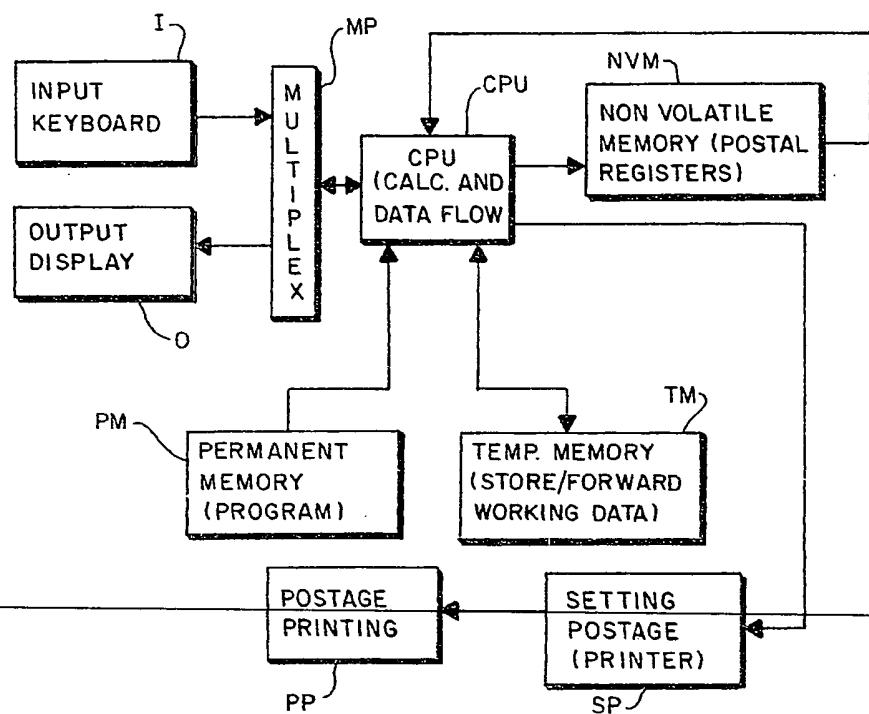
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4. The electronic postage meter of claim 3 wherein said means for preventing includes latching means for continuously blocking the selection of either of said nonvolatile memories.



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21-1

FIG. 1

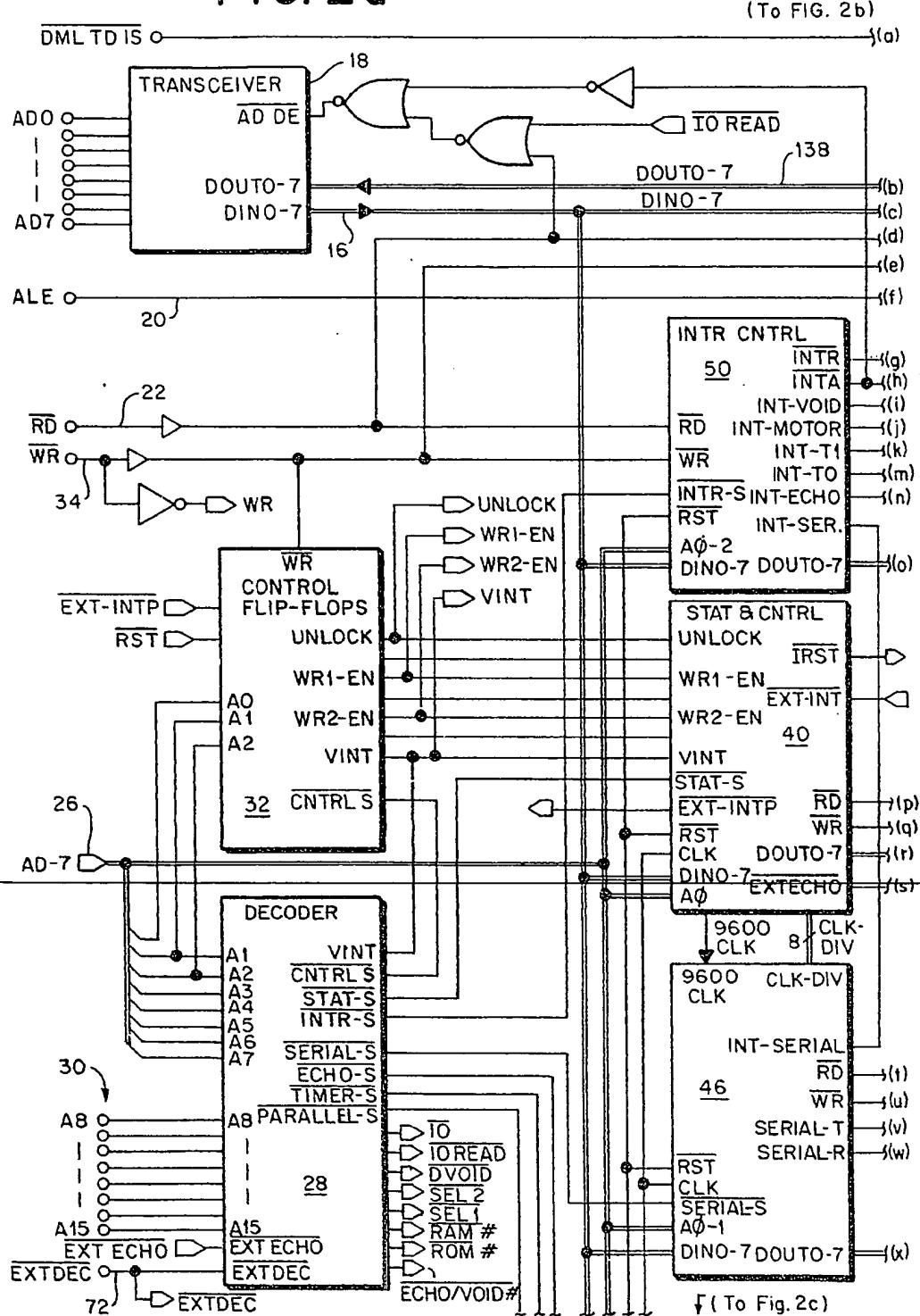


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John Bannister

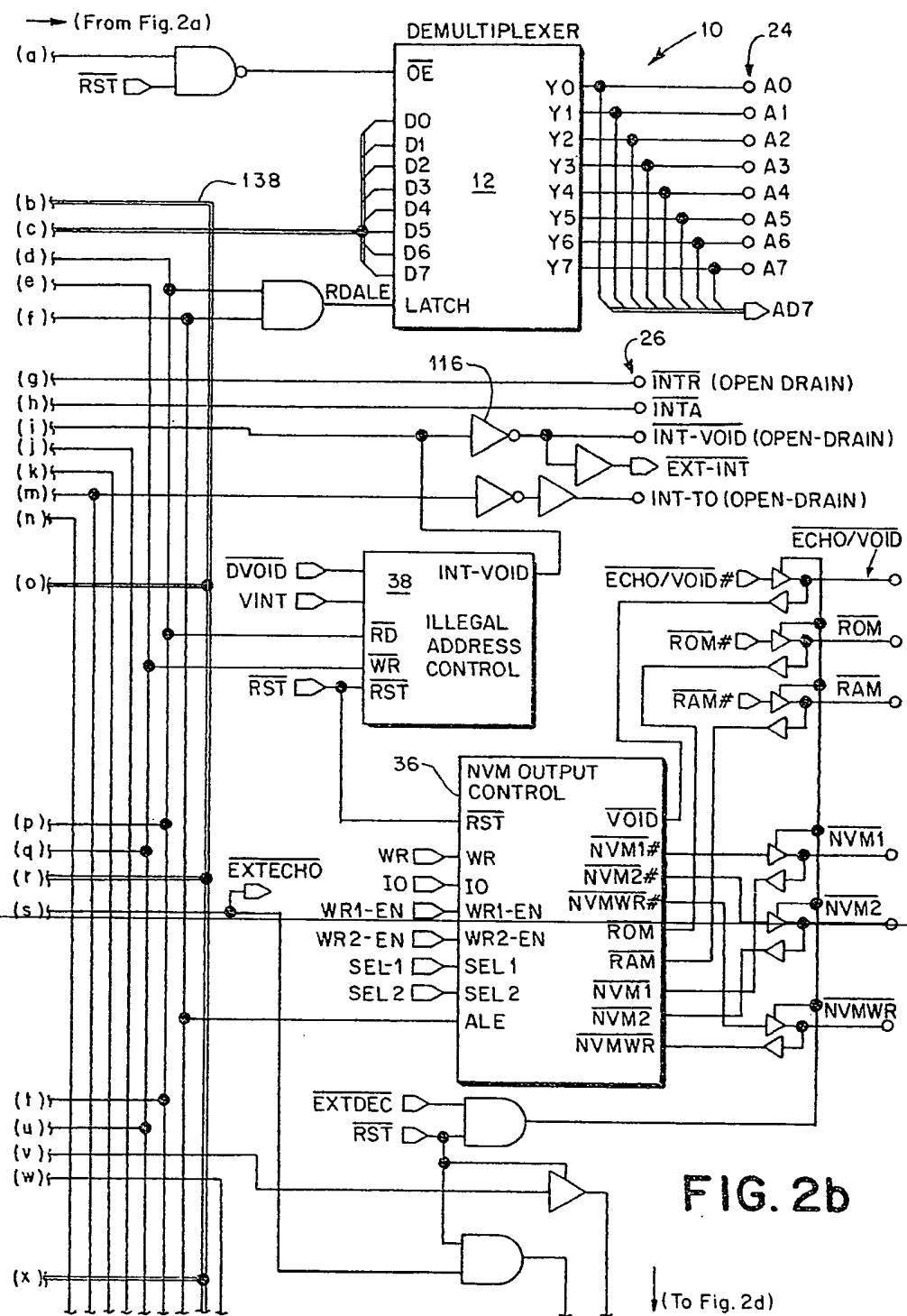
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21-2

FIG. 2a



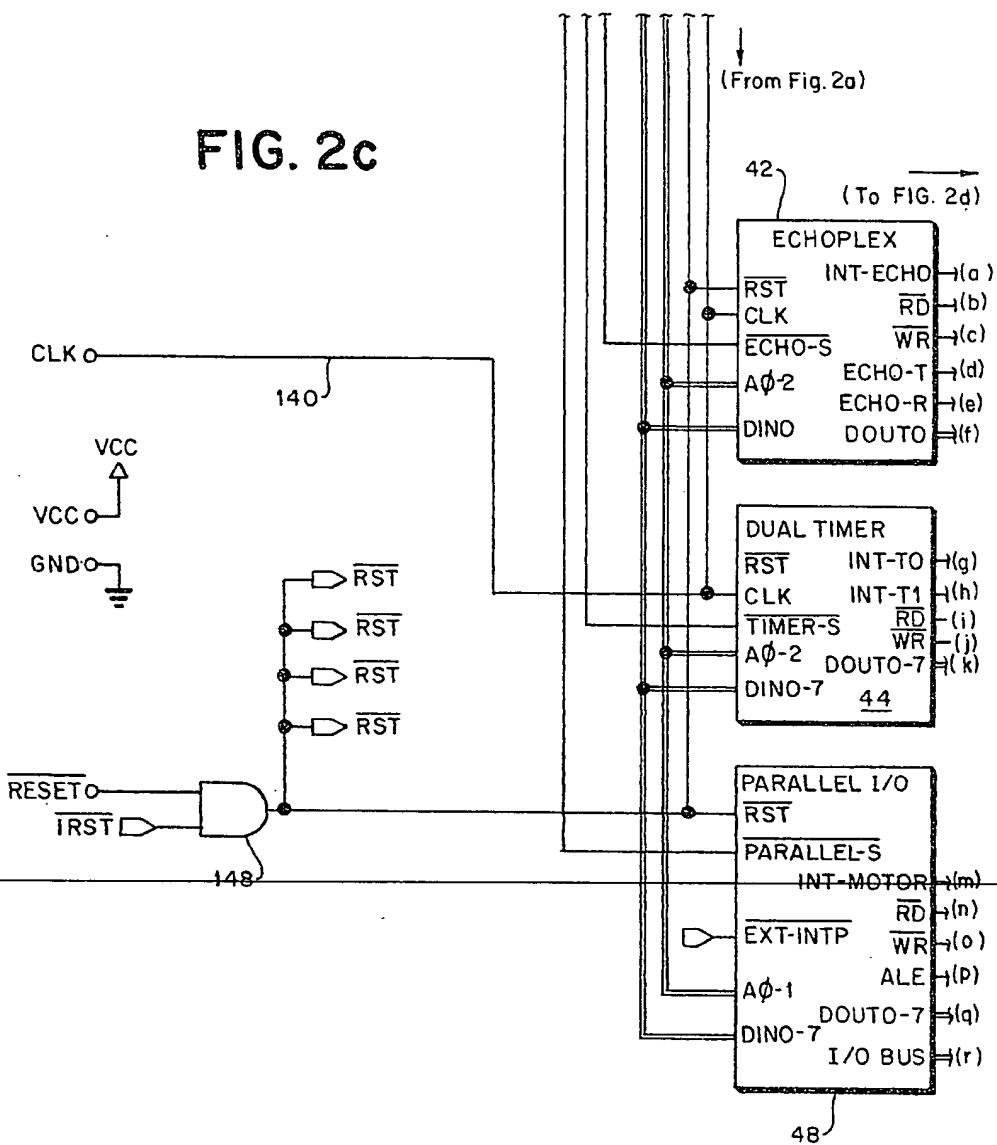
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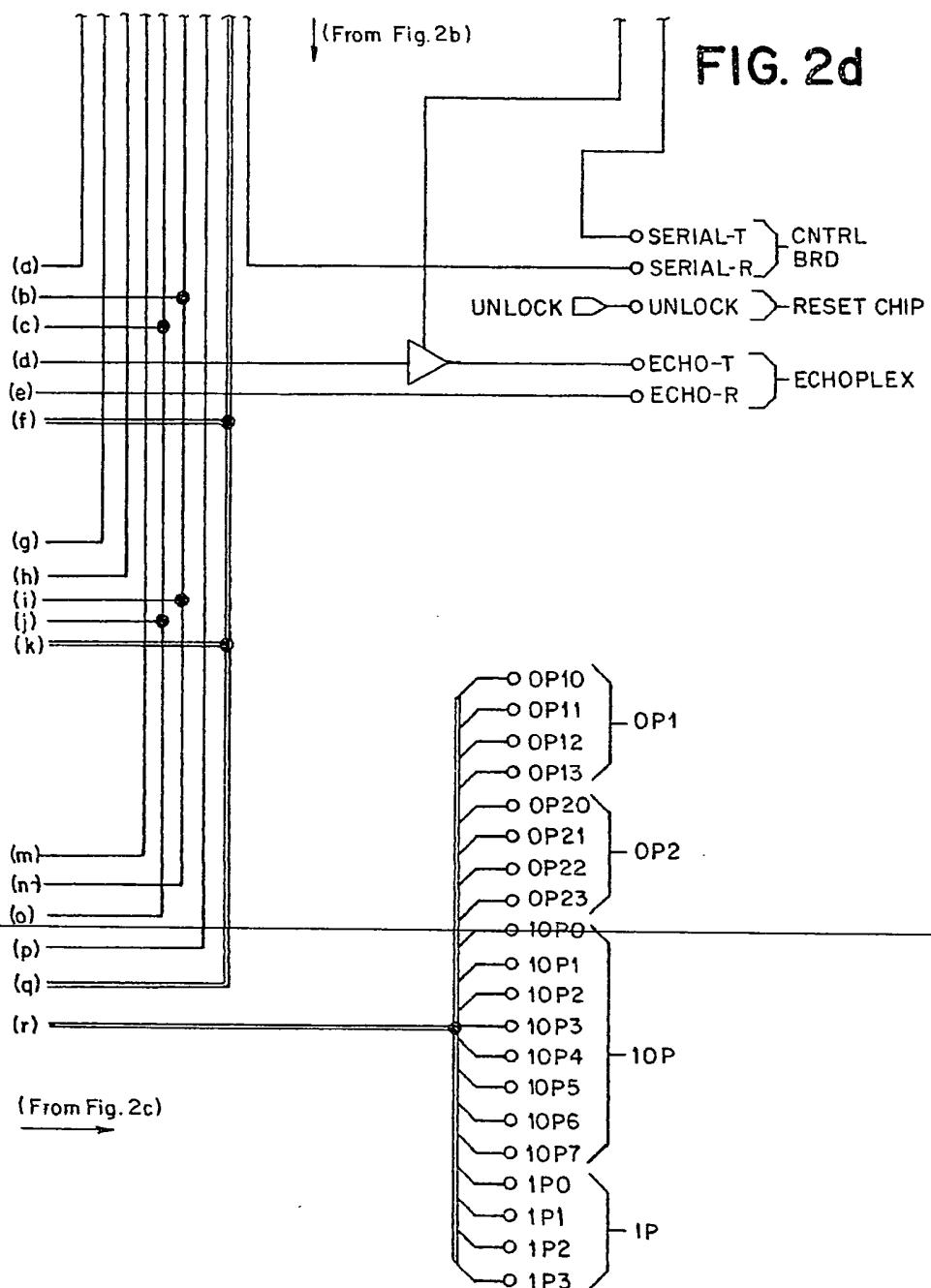


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21-5

FIG. 2d

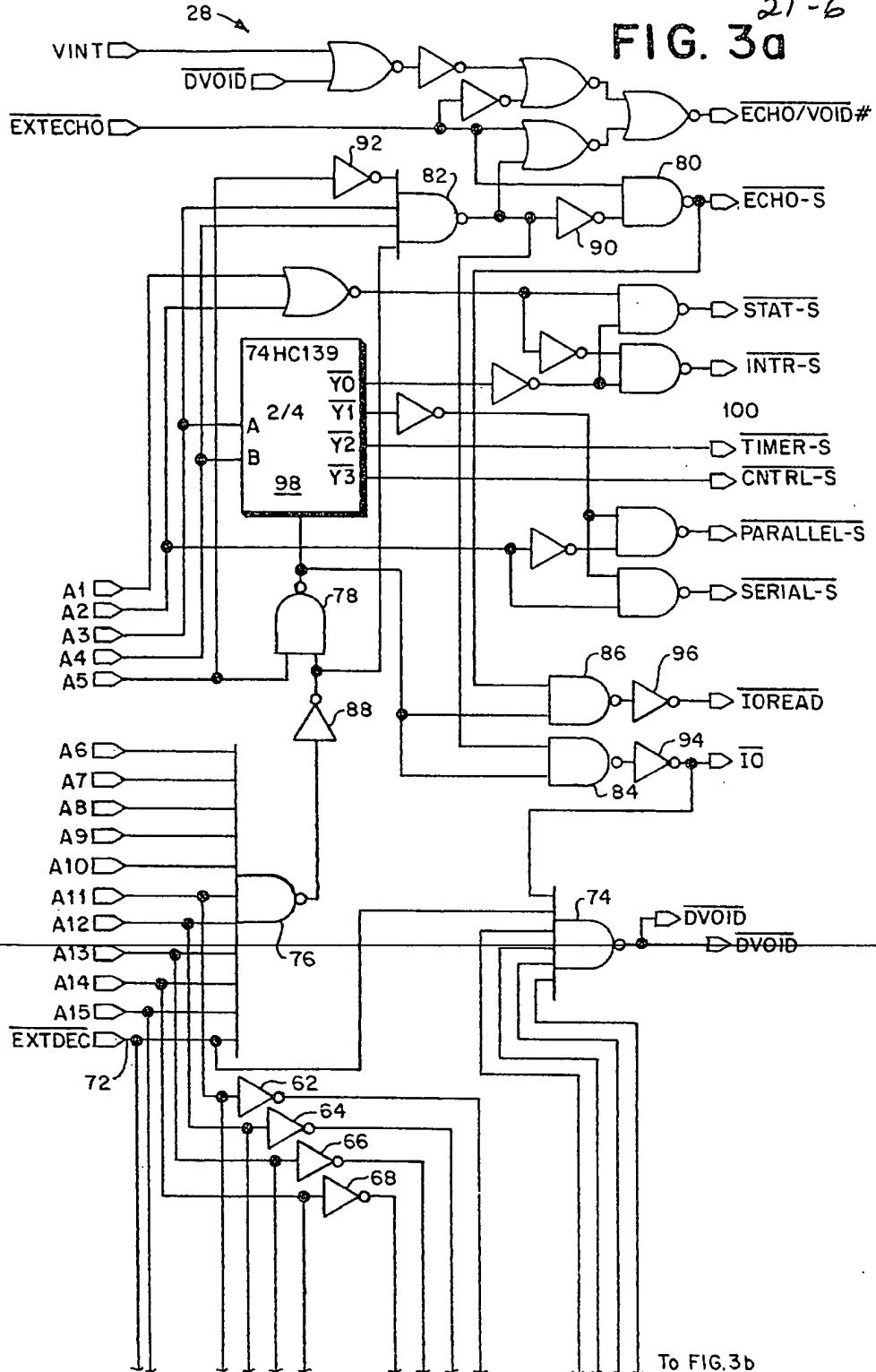


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FIG. 3a

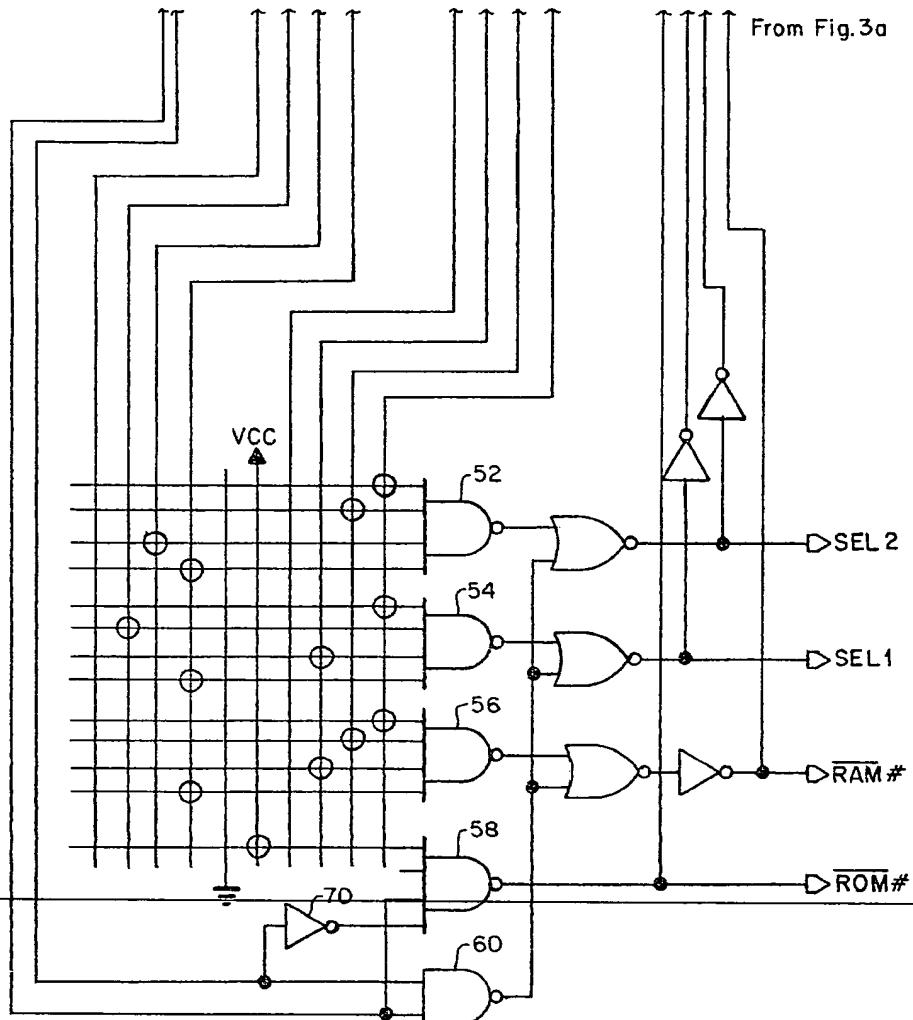


To FIG. 3b

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⊕ INDICATES DEFAULT  
METALIZATION CONTACTS

FIG. 3b

Sent 1/1/1999



Consumer and  
Corporate Affairs Canada

Consommation  
et Corporations Canada

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(45) ISSUED 881220

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C.R. CL. 354-34

(51) INT. CL. G07B 17/02<sup>4</sup>

(19) (CA) **CANADIAN PATENT** (12)

(54) Electronic Postage Meter Having Non-Volatile Memory  
Selection Means

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(73) Granted to Pitney Bowes, Inc.  
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(21) APPLICATION NO. 503,779

(22) FILED 860311

(30) PRIORITY DATE U.S.A. (710,871) 850312

NO. OF CLAIMS 4

Canada

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ELECTRONIC POSTAGE METER HAVING NONVOLATILE  
MEMORY SELECTION MEANS

Abstract

An electronic postage meter having an improved memory selection circuit is disclosed. A custom memory map decoder circuit with resolution down to a single byte location is used to provide selection enabling signals to insure the selection of an appropriate device only when the addresses appropriate to that device are communicated. In accordance with the invention, at least two nonvolatile memories are provided. Writing to either of these nonvolatile memories is inhibited unless one and only one memory is selected. The circuit also prevents the selection of either of the nonvolatile memories in the event that the write strobe signal to the memories is held active.

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ELECTRONIC POSTAGE METER HAVING A NONVOLATILE  
MEMORY SELECTION MEANS

The invention relates to postage meters and in particular to electronic postage meters having microcomputer control of printing and accounting functions.

Devices of this type are generally known, and are discussed for example in U.S. Patent No. 3,978,457. This patent discloses a system for a postage meter which includes a keyboard for the manual introduction of data corresponding to the postage to be printed in a Random Access Memory for real time operation. Data is stored in a nonvolatile memory upon power down and read into the Random Access Memory upon power up.

U.S. Patent No. 4,481,604 describes an electronic postage meter having a redundant memory system in which for each postal printing operation identical data is stored, respectively, in two separate but identical CMOS battery-backed nonvolatile memories.

In these known devices, there have been found to be times when essential data has not properly been stored in the nonvolatile memory of the meter. It has been found that one reason might be the improper selection of access to a particular device.

In known electronic postage meters, the microprocessor high order address bits or combination thereof are utilized in a standard decoder for selecting or enabling a particular

memory or peripheral device to be accessed in accordance with the microcomputer instructions. While this normally works well, in many cases of improper operation of the microcomputer or failure of one of the address lines of the bus, an improper bit may be decoded and the select logic gate which then enables the wrong device may cause wrong data to be read from memory or in the worst case cause data to be written into an unknown memory or peripheral with no indication of any malfunction. When this happens there is a strong possibility of service personnel's not being able to recover essential information from the nonvolatile memory in the postage meter when the postage meter fails.

In accordance with the invention, at least two nonvolatile memories are provided. In order to assure that data is written only to a selected nonvolatile memory, a logic circuit is provided which will decode the addresses called by the microprocessor to select one of these

---

Nonvolatile Memories and which will enable a write strobe signal from the microprocessor to communicate with the NVM only when one and only one memory is selected. The logic circuit also includes means for preventing the selection of either of the nonvolatile memories in the event that the write-strobe signal is held active.

It is accordingly an object of an aspect of the invention to provide a write strobe signal to the nonvolatile memory only when the appropriate addresses are communicated from the microprocessor so as to particularly insure the reading and

writing of the appropriate data into the appropriate location.

It is an object of an aspect of the invention to provide in an electronic postage meter a means for assuring that the  
5 information in nonvolatile memory may be altered only upon further verification that such altering is intended.

It is an object of an aspect of the invention to prevent the writing of information to Nonvolatile Memory under circumstances where such writing would at all times be  
10 enabled due to a malfunction in the Electronic Postage Meter.

An aspect of the invention is as follows:

In a postage meter having a microprocessor for controlling the printing of value and for accounting for the printing of such value and at least two nonvolatile memories for storing  
15 information, said microprocessors being operative to read  
~~information from and write information to said nonvolatile~~  
memories, said microprocessor providing a write strobe signal operative for enabling writing of information into said nonvolatile memories, nonvolatile memory selection  
20 means comprising a logic circuit for selecting one of said nonvolatile memories in accordance with information from the microprocessor, and means for blocking said write strobe signal to said nonvolatile memories when neither of said nonvolatile memories is selected.

Other features and objects of the invention will become apparent in conjunction with the description of the drawing wherein:

FIG. 1 is a block diagram of an electronic postage  
5 meter in accordance with the invention;

FIG. 2 is a block diagram of a specific arrangement of  
a processor interface circuit in accordance with the  
invention;

FIG. 3 is a schematic of a decoder arrangement in  
10 accordance with the invention;

FIG. 4 is a default memory map showing a preferred  
arrangement of memory locations in accordance with the  
invention;

FIG. 5 is an embodiment of a circuit for providing a  
15 plurality of control output signals for NVM access;

FIG. 6 shows a preferred embodiment for providing a  
signal in response to an illegal address selection;

FIG. 7 shows in schematic form a preferred embodiment of a circuit for providing NVM selection;

FIG. 8 shows in schematic form a status and control circuit arrangement;

5 FIG. 9 is a schematic of a circuit for control of interrupts to the system microprocessor;

FIG. 10 is a timing diagram of the events; and  
FIG. 11 is a timing diagram.

Referring now to FIG. 1 which is a block  
10 diagram of a meter in which the invention may be incorporated. Such meters are known and are described for instance in U.S. Patent No. 3,978,457 to Check, et al and assigned to the assignee of the present invention. In this patent, the working memory under  
15 control of the CPU is a Random Access Memory from which data must be transferred to a nonvolatile memory upon loss or shutdown of power to the meter.

U.S. Patent No. 4,481,604 assigned to Roneo Alcatel discloses an electronic postage meter where the  
20 Random Access Memory and the nonvolatile storage memories are combined in battery backed CMOS RAMs which are used both for the real time operation and for long term storage of information in postal registers. EPC Application No. 0 085 385 published August 10, 1983, and  
25 assigned to the assignee of the present invention discloses an improved dual non-memory system. It will be appreciated by those skilled in the art that such a device may be combined with the electronic postage meter described in Check and is also suitable for the  
30 invention disclosed herein. The decoder arrangement disclosed herein is conveniently used to provide a method and apparatus for further protecting essential postal data in conjunction with the circuit described in Canadian Application Serial No. 503,785 filed on even  
35 date herewith entitled POSTAGE METER WITH A NONVOLATILE MEMORY PROTECTION CIRCUIT and assigned to the assignee of the present invention.

Still referring to FIG. 1, the heart of the general functional arrangement of the system is the CPU which is utilized with specific instructions programmed in the Read Only Memory (PM), for the performance of control of the basic meter functions, for the performance of calculations based on any input data and for controlling the flow of data into the various memories.

The system, may operate in accordance with data applied from an appropriate input means "I" or from a communications means "C" such as described for instance in U.S. Patent No. 4,301,507 to Soderberg. The data is fed into the CPU under control of the program in Read Only Memory and at any time during the operation of the system, should the contents of the memory storing the appropriate credit/debit balances or other cumulations in accordance with various features of the system be desired to be displayed, appropriate instructions provided by the input means "I" cause the CPU to access the desired locations in memory which store the information requested.

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The information may be displayed on an output unit "O". As well known, the input and output units may be multiplexed by a suitable multiplex unit "MP" for transferring data to and from the CPU.

FIG. 2 is a block diagram of a specific arrangement of a processor interface circuit in accordance with the invention and comprises an address decoder and associated selection circuitry for the selection and control of various elements of the Electronic Postage Meter. It will be appreciated that the circuit arrangement herein described is preferably embodied in a custom LSI microchip, however, it will be understood that the use of conventional logic components is also contemplated.

Turning now to FIG. 2, the overall block diagram of the circuit is shown generally at 10. The demultiplexer 12 in conventional manner demultiplexes the address/data bus 14 of a microprocessor (not shown in FIG. 2), suitably an 8085 series microprocessor available from the Intel Corporation or an NSC800 series microprocessor available from the National Semiconductor Corporation. The bus 14 communicates with the demultiplexer 12 on communication lines 16 through a conventional transceiver circuit arrangement 18. For best results the ADDRESS LATCH ENABLE (ALE) signal 20 from the microprocessor is "anded" with the microprocessor read strobe signal 22 to provide the latching signal for latching the address information for the demultiplexer 12.

The demultiplexed address information is fed out on lines 24 for use in other parts of the EPM and are internally

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connected at 26 to the decoder section 28. The high order address signals directly from the microprocessor are communicated on lines 30 to the decoder section 26. An external decode signal, EXTDEC, is also input to the decoder section 28.

The decoder section 28 receives and decodes a complete input address received at 26 and 30 to provide select outputs for the various parts of the system. The low order demultiplexed address lines A<sub>0</sub>, A<sub>1</sub> and A<sub>2</sub> are utilized as inputs to control flip-flops 32 along with the microprocessor write strobe WR received at 34 from the microprocessor. As described further below, the control flip-flop section generates four control signals in response to these inputs in addition to a decoder reset signal and other derived signals, i.e. EXT-INTP, a pulse signal generated at the activation of the illegal memory access output pin, and a select signal CTRL-s for the selection of the Control Flip Flop block.

Outputs from the decoder 28 are provided to NVM output control block 36. This control block 36 in accordance with the invention provides a fail-safe NVM device selection. The selection of either NVM is disabled if the NVM write line is shorted to the "active" state. The NVM write strobe is disabled whenever the other devices are selected or in the event that both NVMs are simultaneously selected.

In accordance with the invention, an illegal address control block 38, in conjunction with the decoder 28 detects when the microprocessor read or write strobes attempt to access addresses an illegal, i.e. unused, memory space and,

as discussed below, provides a signal output for interrupting the processor.

Status and control block 40 monitors the outputs from the control Flip-Flop section and provides a control port to generate a decoder reset and to control the selection of an internal or external communication through an "Echoplex" I/O section 42. Preferably the section also includes an 8-bit timer to set the Transmit Baud rate for the serial communications.

Dual Timer section 44 provides two programmable 16-bit timers. Preferably the system clock is the clock input to the timers. Suitably each is programmable for continuous or for one-shot operation for generating an interrupt when the programmed count is completed. Conveniently an 8-bit counter divider can be selected to prescale the clock input or the ripple output of the first timer may be selected as the clock input to the second timer.

Conveniently serial I/O block 46 and parallel I/O ~~block 48~~ are utilized for communication with a keyboard and display and for motor control, sensing postal value and miscellaneous control functions.

For best results, an Interrupt Status and Control Block 50 is provided along with an interrupt mask control port for enabling selected interrupts to interrupt the systems processor.

FIG. 3 shows a schematic of an embodiment of a decoder block for providing a decoded memory map in accordance with the invention. The crossed lines with a circle superposed

are used to indicate the preferred conductive path in a customized chip arrangement. It will be appreciated that the illustrated arrangement is extremely convenient in that the decoded memory map as described below may be modified easily with only a few mask changes.

The various addresses communicated in known manner from the microprocessor and demultiplexer as described previously are each fed to leads A1 through A15 of the decoder block 28. The address bits on address lines A11 through A15 are supplied to NAND gates 52, 54, 56, 58, and 60 and inverted at inverters 62, 64, 66, 68, and 70 and applied as illustrated to the NAND gates 52, 54, 56, and 58. An external decode signal 72 (see also FIG. 2) is applied to NAND gate 60. The output of NAND gate 60 is NOR'D with the outputs of gates 52, 54, and 56. The EXTDEC signal is also applied directed to gate 58. It will be noted that when "active" this signal will disable the decode function. The decoded outputs from the connections illustrated in FIG. 3 for the preferred embodiment are as shown in Table I and in

---

FIG. 4.

TABLE IOUTPUTS

ROM#	: SELECT FOR EXTERNAL PROM MEMORY
RAM#	: SELECT FOR EXTERNAL RAM MEMORY
SEL1	: FOR GENERATING THE SELECT FOR EXTERNAL NVM#1
SEL2	: FOR GENERATING THE SELECT FOR EXTERNAL NVM#2
CNTRL-S\	: SELECT FOR INTERNAL CONTROL FLIP-FLOP BLOCK
INTR-S\	: SELECT FOR INTERNAL INTERRUPT CONTROLLER
STAT-S\	: SELECT FOR INTERNAL STATUS BLOCK
TIMER-S\	: SELECT FOR INTERNAL DUAL-TIMER BLOCK
ECHO-S\	: SELECT FOR INTERNAL ECHOPLEX BLOCK
SERIAL-S\	: SELECT FOR INTERNAL SERIAL I/O BLOCK
PARALLEL-S\	: SELECT FOR INTERNAL PARALLEL I/O BLOCK
ECHO/VOID#\	: SELECT FOR EXTERNAL ECHOPLEX BLOCK OR SPARE DECODE SIGNAL WHEN UNUSED MEMORY SPACE IS SELECTED (OR NEITHER)
IO\	: ACTIVE WHEN ANY I/O SELECTS ARE ACTIVE
IOREAD\	: ACTIVE WHEN ANY OF THE INTERNAL SELECTS ARE ACTIVE
DVOID	: ACTIVE WHEN "ExtDec\" IS INACTIVE AND WHEN NONE OF THE SELECT OUTPUTS ARE ACTIVE

<u>OUTPUT SIGNAL</u>	<u>ADDRESS RANGE(S)</u>	<u>SIZE</u>
ROM#	0000 - 7FFF	32 KBYTES
RAM#	C000 - C7FF	2 KBYTES
SEL1	D000 - D7FF	2 KBYTES
SEL2	E000 - E7FF	2 KBYTES
ECHO-S\	FFD8 - FFDF	8 BYTES
STAT-S\	FFE0 - FFE1	2 BYTES
INTR-S\	FFE2 - FFE7	6 BYTES
PARALLEL-S\	FFE8 - FFEB	4 BYTES
SERIAL-S\	FFEC - FFFF	4 BYTES
TIMER-S\	FFF0 - FFF7	8 BYTES
CNTRL-S\	FFF8 - FFFF	8 BYTES
IO\	FFD8 - FFFF	48 BYTES
IOREAD\	FFD8 - FFFF; IF "EXTECHO\" INACTIVE FFE0 - FFFF; IF "EXTECHO\" ACTIVE	

It will be noted that in accordance with the invention, an active DVOID output is provided from NAND gate 74 when none of the system's blocks are selected. It will also be clear to one skilled in the art that the address bits, when appropriately decoded as in the illustrated circuit by NAND gates 76, 78, 80, 82, 84, and 86 and inverters 88, 90,

92, 94, and 96 provide an "active" output I/O whenever any of the I/O functions is selected and an "active" I/O read output whenever any of the internal circuit functional blocks are selected. Address bits A3 and A4 are applied to 2-to-4 demultiplexer 98 and decoded with other low order address bits for providing output signals as defined in Table I for selecting the appropriate blocks.

It will be understood that the signal DVOID is not necessarily limited to its previously described function. For instance, in the illustrated embodiment, a signal VINT from the control flip-flop block further described below may be used to convert this DVOID signal to another decode output. This signal shown as "ECHO/VOID" in FIG. 3 is available if the circuits internal ECHOPLEX block 42 is utilized. Alternatively it will be seen that if an external "echoplex" section is utilized, that is, when the signal "EXTECHO" is "active" the "ECHO/VOID#" output becomes the "select" signal for the external block and the "select" signal for the internal echoplex section, "ECHO-S" is disabled.

As mentioned previously, the Control Flip-Flop section 32, more particularly shown in FIG. 5, generates four control output signals and their complements for controlling the generation of an illegal address interrupt signal to the processor, to provide an independent enable/disable for the access to two separate NVM storage devices, to enable and disable meter postage printing and access to nonvolatile storage.

As best seen in FIG. 5 the low order address signals A<sub>0</sub>, A<sub>1</sub>, and A<sub>2</sub> are fed to a 3-to-8 Line Decoder Multiplexer 102 equivalent to a 74HC138 available from RCA to set and reset flip-flops 104, 106, 108, and 110. The processor strobe signal WR and the select signal CNTRL-S are applied to the enable inputs of decoder 102. As illustrated, it is apparent that the control flip-flops are selectively controlled when both these signals are "active".

The decoder reset signal RST and EXT-INTP (a pulse signal generated at the activation of the illegal memory access interrupt signal) are "NAND'D" at "NAND" gate 112, inverted at inverter and applied to each of the flip-flops 104 and 110. Table II shows the preferred decoded control signals in response to the appropriate addresses.

TABLE II

A <sub>0</sub> -2	DECODED CNTRL	FLIP-FLOP	OUTPUT	
Ø	VINT-CLR\	VINT	INACTIVE	
1	VINT-EN\	VINT	ACTIVE	PRESET
2	WR2-RESET\	WR2-EN	INACTIVE	PRESET
3	WR2-SET\	WR2-EN	ACTIVE	
4	WR1-RESET\	WR1-EN	INACTIVE	PRESET
5	WR1-SET\	WR1-EN	ACTIVE	
6	UNLOCK-SET\	UNLOCK	ACTIVE	
7	UNLOCK-CLR\	UNLOCK	INACTIVE	PRESET

The outputs from flip-flop 104 designated UNLOCK are preferably active to enable postage printing and for NVM access. For best results, the preset value is inactive to prevent printing and NVM access. The signal WR1-EN and WR2-EN are "active" for write access to respective NVM devices #1

and #2. Again, for best results the preset values are "inactive".

The output VINT which as previously discussed is fed to the decoder section 28 is active to enable an interrupt generation whenever an illegal memory access is attempted. It will be appreciated that this is preferred since in the "inactive" state it may be used to reset the generated interrupt signal or to disable the interrupt so that it may be used as a spare decode output. The VINT preset signal is "active" to enable the interrupt.

The illegal address control block 38 is shown more particularly in FIG. 6. This circuit is used to provide an indication of when access to unused memory space is attempted.

The DVOID decoded signal output from the decoder section 28 is nanded at NAND gate 106 with the  $\bar{Q}$  output from a D Flip-Flop 108. The processors read strobe  $\bar{RD}$  and write strobe  $\bar{WR}$  are NAND'D at NAND gate 110, inverted and applied to the clock input of the D flip-flop 108. The decoder reset signal is NANDED with the "VINT" signal from the control flip-flop section 32 at NAND gate 112 and applied to the RESET input shown as  $\bar{CLR}$  in the Figure.

Thus, depending upon the status of the signal VINT as discussed previously, the decoded void memory space indication will be latched at the lead edge of either the read or the write strobe of the microprocessor to provide the output INT-VOID from the Q terminal of flip-flop 108. In accordance with the invention, the INT-VOID signal is

provided to the system microprocessor as an interrupt signal. Preferably this indication will remain latched until reset by the reset signal from the microprocessor.

Conveniently as seen in FIG. 2 the output is inverted at inverter 116 and supplied at 118 at INT-VOID.

For best results, this INT-VOID output pin in open-drain so as to permit any of a number of open-drain outputs wire-ored to this pin to activate the output signal. This output pin is then suitably tapped as the input signal EXT-INT which is furnished to the Status and Control Block. There, this signal is provided as a status port bit and upon its actuation, a 1 clock period pulse is generated on signal EXT-INTP. This EXT-INTP is provided from the status and control section to reset the control flip-flop and parallel I/O sections to their default (safe) states when the INT-VOID output pin is activated.

Turning now the FIG. 7, the NVM Output Control Block 36 is shown in greater detail. In order to insure secure accounting in the NVM the WRITE access to the two independent NVM devices is independently enabled and disabled under software control.

The NVM OUTPUT CONTROL will block the microprocessor write strobe WR unless either of the NVM decoded select signals SEL1 and SEL2 is available and the appropriate write enable signal from the control flip-flops are available at NAND gates 118 and 120. The output of these gates are inputs to NAND gate 122 whose output is applied to NAND gate 124.

The output of this gate is inverted and supplied to NAND gate 126.

The other signals applied to NAND gate 124 are the decoded select signals NVM1, NVM2, ROM, RAM and VOID are taken from the output drivers and applied to NAND gate 124, with NVM 1 and NVM2 being NOR'D at NOR gate 128 and inverted before being applied to 124. It will be appreciated that the write strobe WR is blocked if the appropriate memory space is not selected. It will also be appreciated that if both NVMs are selected simultaneously the write strobe will also be blocked.

A further protection feature is provided in the event that the NVM write strobe output is shorted "active". The address enable strobe at 20 is applied as the clock signal to a D flip-flop 130. If the NVMWR is shorted active, the ALE signal clocks the Q output low to block both of the NVM device selection signals at NAND gates 132 and 134.

FIG. 8 is a schematic of the status and control block.

The block comprises a status port to allow monitoring of the control flip-flop outputs. The outputs of the control flip-flop block 32 are applied to buffer 136 for output to data bus 138, see also FIG. 2. The system clock input from 140 (see FIG. 2) is used in conventional fashion for timing the internal reset output by counting through D flip-flops 142, 144, and 146 to provide signal IRST which is the control signal for resetting all of the flip-flops in the circuit and is applied along with the System Reset to AND gate 148, (see FIG. 2).

The block select signal STAT-S for this block, the write strobe, read strobe, and lowest order address bit are decoded to clock the writing of data at octal flip-flop 150, for initiating a general decoder reset under the control of appropriate software commands and for setting a baud-rate divider circuit if desired. The EXTECHO signal from D flip-flop 152 is used as previously discussed for selection of an external communication device (not shown).

The Interrupt Controller block 50 is shown in more detail in FIG. 9. The interrupt controller in accordance with the invention provides great flexibility in the servicing of the various interrupt signals to the microprocessor. The signal INT-VOID from the illegal address control block 38, signals INT-TO and INT-TI generated by the time-out of timers in timer block 44, signal INT-ECHO from the ECHOPLEX block 42 which is "active" to indicate the start of an echoplex message, signal INT-SERIAL from serial I/O block 46 which is "active" when new data is received or when the port is read for sending data, and signal INT-MOTOR from PARALLEL I/O block 48 which is preferably "active" when an illegal motor control output has been communicated are each input to the INTERRUPT CONTROLLER block 50. The status of each of these signals may be read out directly from buffer 154 when the RD-INTR signal is "active".

Signal INTA from the system microprocessor is an interrupt acknowledge. It will be appreciated that if the INTA line is held or tied in the "inactive" state, each interrupt signal input applied through gates indicated

generally at 156 and fed to NAND gate 158 will create an interrupt request signal INTR for communication to the system's microprocessor. Preferably, mask bits may be fed as data on data input bus 16 for providing masking bits to D-flip-flops 160 for latching. The latched outputs from 160 are applied to gates 156 so that the interrupt request will be generated whenever an unmasked device requests service. The particular device requesting service may be determined by reading the status buffer 154. The interrupt lines are also coded at the gates indicated generally at 162 for feeding to latch 164 which also provides similar information.

Preferably, as shown, there is also included a vectored interrupt for the handling of service requests. As discussed previously, a non-masked interrupt results in the generation of an interrupt-request signal to the systems microprocessor. For best results, the microprocessor upon receiving this signal will transmit an interrupt acknowledge signal INTA. This signal places the contents of the opcode latch 166 onto the data bus. In accordance with the invention, the processor interprets this data as an opcode, normally a call instruction for the microprocessor. Upon execution of the instruction, the microprocessor generates another INTA pulse to enable the lower vector latch 168. The encoding of bits on this latch as described above. The vector thus generated, desirably reflects a predetermined code representing the highest priority interrupt. The next INTA pulse, in response to the call of this OPCODE, will

place the data residing in latch 170, preferably the upper vector address data, onto the data bus 138.

The INTR-S signal is utilized to select this block. The low order address signals A0 through A2 are used as illustrated to decode the various control signals on the gates indicated generally at 140.

Echoplex circuits suitable for use in block 42 are discussed in U.S. Patent No. 4,301,507 incorporated by reference herein. Serial I/O and parallel I/O port circuits are well known and will not be discussed further herein.

FIG. 10 and FIG. 11 are timing diagrams showing the interrelationship of signals previously discussed. The designated parameters and preferred timing are shown in TABLE III. It is believed that these diagrams will be readily understood by those skilled in the art so they will not be further described except with regard to the operation of the circuit.

TABLE III

SYMBOL	PARAMETER	MIN	MAX	UNIT	NOTE
$t_{ALE}$	ALE STROBE WIDTH	75		ns	CONDITION
$t_{AHS}$	AE-15 SET-UP TIME	50		ns	CONDITION
$t_{ALS}$	ADP-7 SET-UP TIME	40		ns	CONDITION
$t_{ALH}$	ADP-7 HOLD TIME	30		ns	CONDITION
$t_{ARW}$	ALE TO RD\ OR WR\ STROBE	125		ns	CONDITION
$t_{RDW}$	RD\ STROBE WIDTH	225		ns	CONDITION
$t_{WRW}$	WR\ STROBE WIDTH	220		ns	CONDITION
$t_{WS}$	WRITE DATA SET-UP TIME	50		ns	CONDITION
$t_{INW}$	INTERRUPT PULSE WIDTH	125		ns	
$t_{ACC}$	ALE TO VALID DATA		300	ns	
$t_{ALD}$	ALE TO VALID AE-7		50	ns	$t_{ACC MAX} = 250\text{ns}$
$t_{(CE)PD}$	AE-15 TO :				
	ROM\ ENABLE STROBE		50	ns	$t_{ACC MAX} = 250\text{ns} + t_{AH MIN}$
	RAM\ ENABLE STROBE		50	ns	$t_{ACC MAX} = 250\text{ns} + t_{AH MIN}$
	NVM1\ ENABLE STROBE		60	ns	$t_{ACC MAX} = 280\text{ns} + t_{AH MIN}$
	NVM2\ ENABLE STROBE		60	ns	$t_{ACC MAX} = 280\text{ns} + t_{AH MIN}$
	ECHO/VOID\ STROBE		70	ns	$t_{ACC MAX} = 280\text{ns} + t_{AH MIN}$
$t_{DS}$	INPUT PORT DATA SET-UP TIME		50	ns	
$t_{WH}$	WRITE DATA HOLD TIME	75		ns	
$t_{NWD}$	WR\ TO NVMWR\ DELAY		35	ns	$t_{WH MIN} = t_{NWD MAX}$
$t_{NWH}$	WRITE DATA HOLD TIME AFTER NVMWR\		50	ns	$t_{WH MIN} = t_{NWD}$
$t_{DO}$	WR\ TO OUTPUT PORT DATA VALID		75	ns	$t_{WH MIN}$
$t_{RH}$	AE-7 HOLD TIME AFTER RD\	0		ns	
$t_{RDH}$	DATA HOLD TIME AFTER RD\	0	50	ns	
$t_{RWI}$	RD\ OR WR\ TO INTR\		90	ns	
$t_{DMLT}$	DMLDIS\ TO AE-7 FLOAT		25	ns	
$t_{EXT}$	EXTDEC\ to CE's FLOAT		25	ns	

The operation of the circuit has been particularly described with respect to each of the functional units. Broadly, however, the circuit 10 in accordance with the invention receives and decodes the periodic address signals communicated from the microprocessor and received at decoder block 28 and control flip-flop block 32. The address signals are decoded to provide an "active" selection signal for each of the various blocks of the circuit 10 and the memory devices of the electronic postage meter depending upon the communication of the appropriate addresses for the particular device. In the event that an illegal address is communicated either because of a microprocessor or software failure or because of a failure in the instant circuit, the DVOID signal from the decoder block 28 goes "active" causing the output of gate 106 (FIG. 6) to go high and latching the Q output of flip-flop 108 active. Thus a latched interrupt signal is sent to the interrupt control block 50 for communication to the microprocessor which responds as previously described above in conjunction with FIG. 9 whenever an illegal access is attempted.

As discussed previously, further protection is provided in the event that both nonvolatile memories are selected. As seen in FIG. 7, if both the NVMI and the NVM2 signals are active the output of gate 128 is high. This output is inverted and applied to gate 124 whose output is then held high so long as both devices are selected. The output of 124 is inverted and the low input to gate 126 blocks the microprocessor's write strobe WR to the NVM. It

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will also be appreciated that an additional interlock exists on the write access to each NVM by way of control flip-flops WR1-EN and WR2-EN. Under software control, write access is provided to NVM1 only when WR1-EN is set. Similarly, write access is provided to NVM2 only when WR2-EN is set.

Protection is also provided during system power up with the use of the unlock control flip-flop signal. It is a master control of access to the NVM's and postage printing which will disable these functions until the software operating system is ready to enable them.

In order to assure that signal NVMWR, the output from gate 126 is not shorted active and so to assure that writing to the NVM is being commanded by the microprocessor, the selection of a nonvolatile memory is blocked if NVMWR is held active. The output write enable signal NVMWR is fed to latch 130 (FIG. 7) which is clocked by the address-latch-enable signal (ALE) from the microprocessor. The Q output from the latch which is normally high is used to enable gates 132 and 134.

If NVMWR is active when the ALE signal becomes active, the Q output of latch 130 goes high and blocks the output of gates 132 and 134. Thus in order for a nonvolatile memory to be selected there must be a periodically active nonvolatile memory write enabling signal and selection of only one nonvolatile memory to assure that the microprocessor is providing the appropriate data to the appropriately selected NVM.

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It will be understood that the claims are intended to cover all changes and modifications of the embodiment herein chosen for the purpose of illustration which do not constitute departures from the scope and spirit of the invention.

What is claimed is:

1. In a postage meter having a microprocessor for controlling the printing of value and for accounting for the printing of such value and at least two nonvolatile memories for storing information, said microprocessor being operative to read information from and write information to said nonvolatile memories, said microprocessor providing a write strobe signal operative for enabling writing of information into said nonvolatile memories, nonvolatile memory selection means comprising a logic circuit for selecting one of said nonvolatile memories in accordance with information from the microprocessor, and means for blocking said write strobe signal to said nonvolatile memories when neither of said nonvolatile memories is selected.
2. The electronic postage meter of claim 1 including means for blocking the write strobe signal whenever both nonvolatile memories are simultaneously selected.
3. The electronic postage meter of claim 1 further comprising means for preventing the selection of either of said nonvolatile memories in the event that the write strobe signal communicated to said nonvolatile memories is held in an active state.

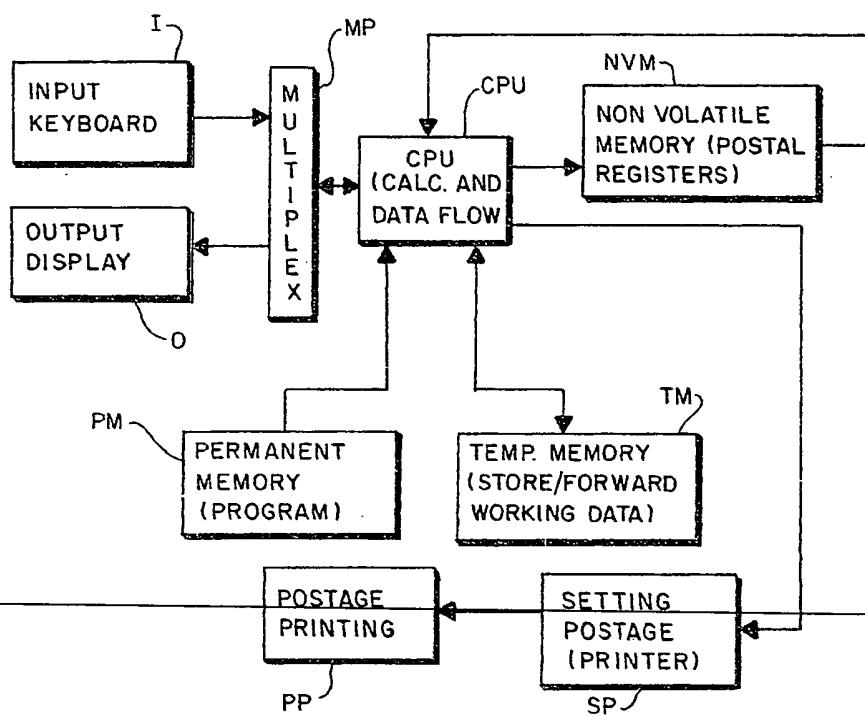
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4. The electronic postage meter of claim 3 wherein said means for preventing includes latching means for continuously blocking the selection of either of said nonvolatile memories.



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FIG. 1

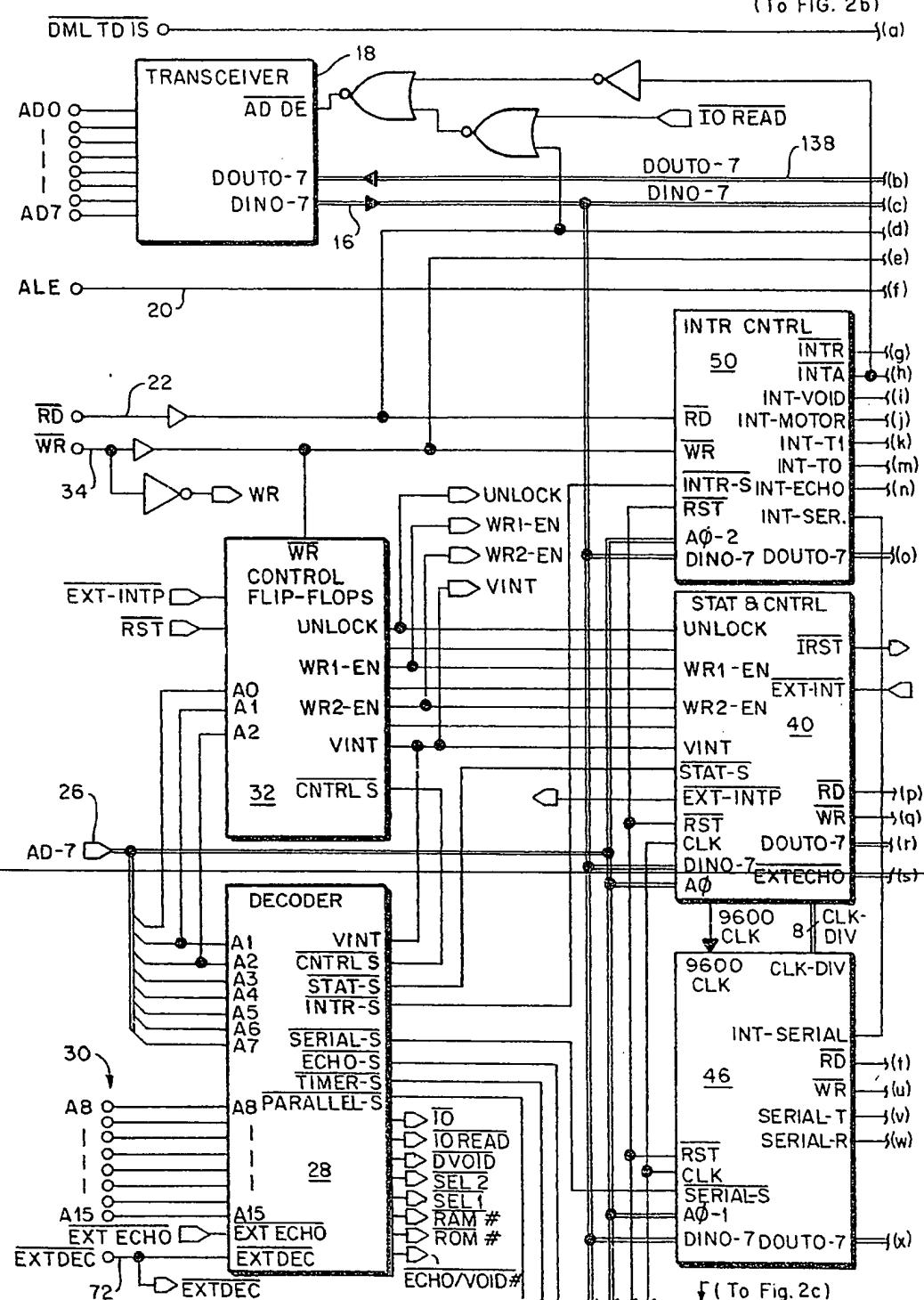


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FIG. 2a



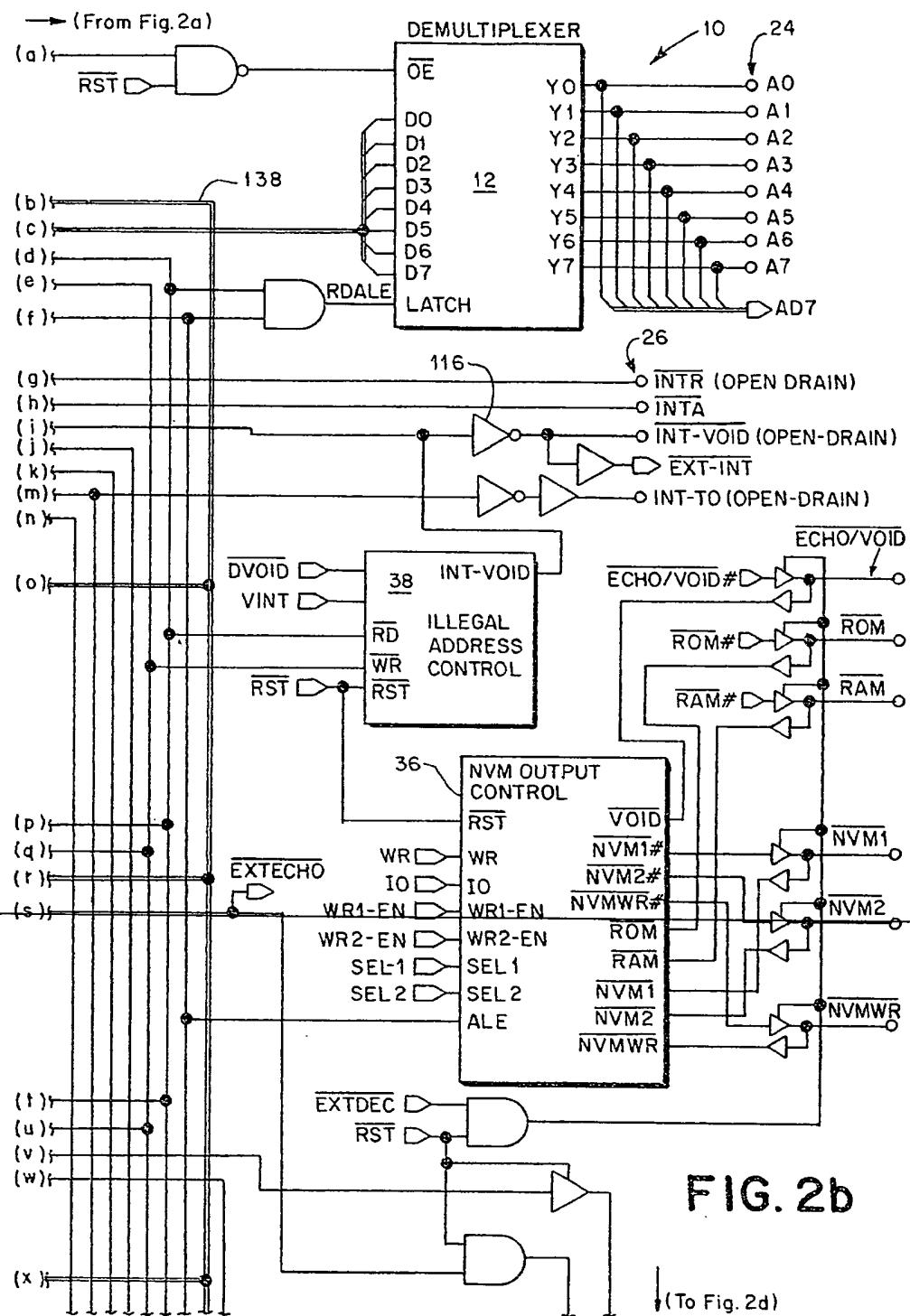


FIG. 2b

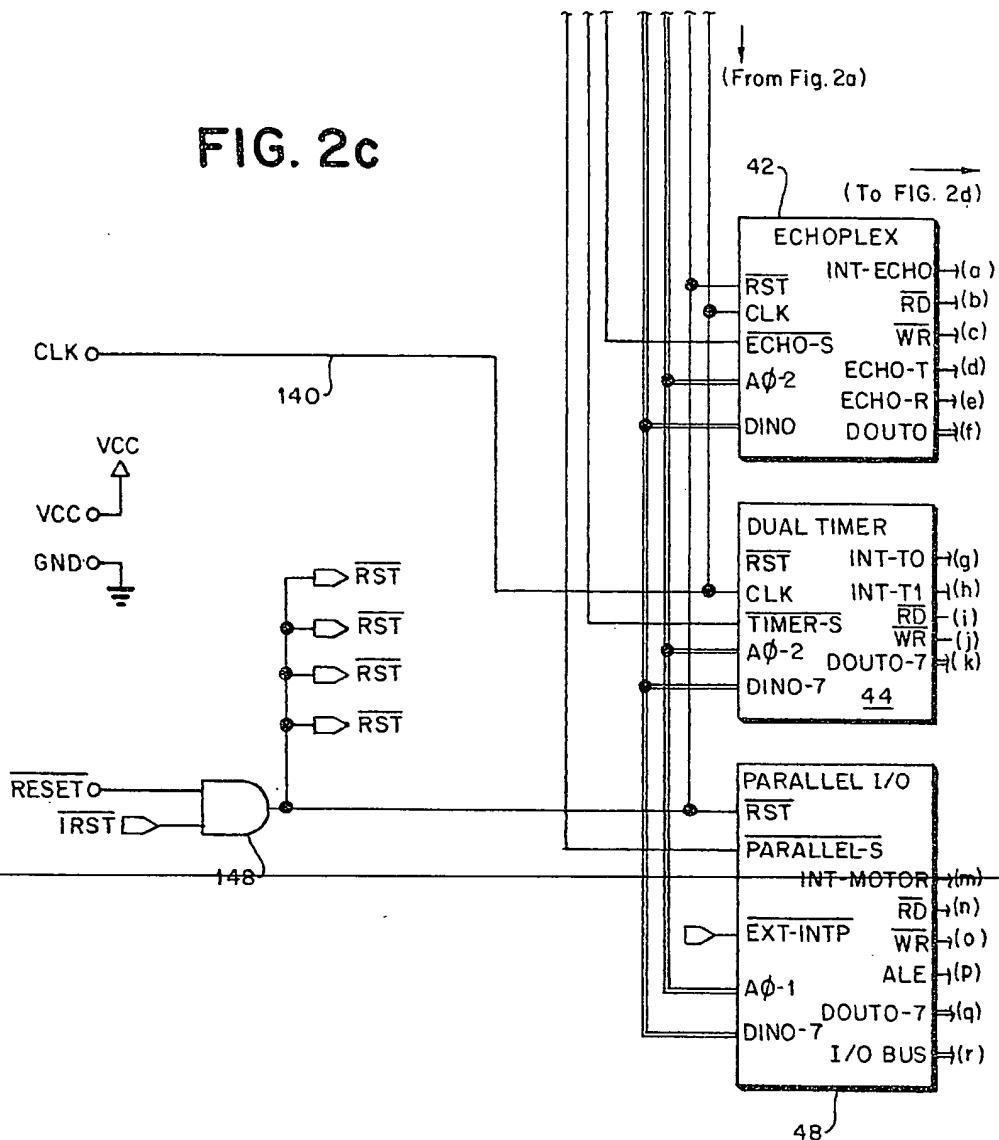
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(To Fig. 2d)

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FIG. 2c

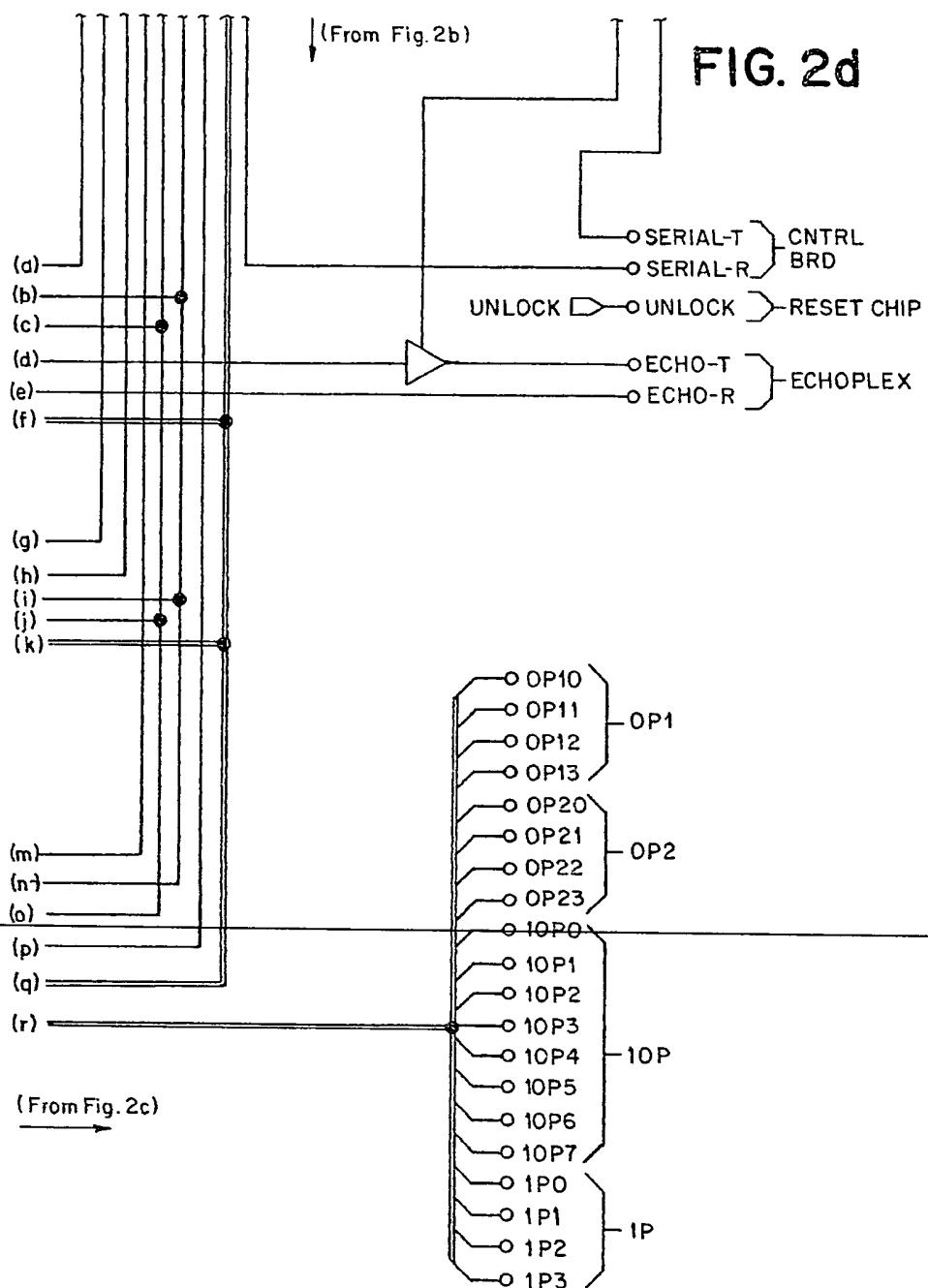


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FIG. 2d

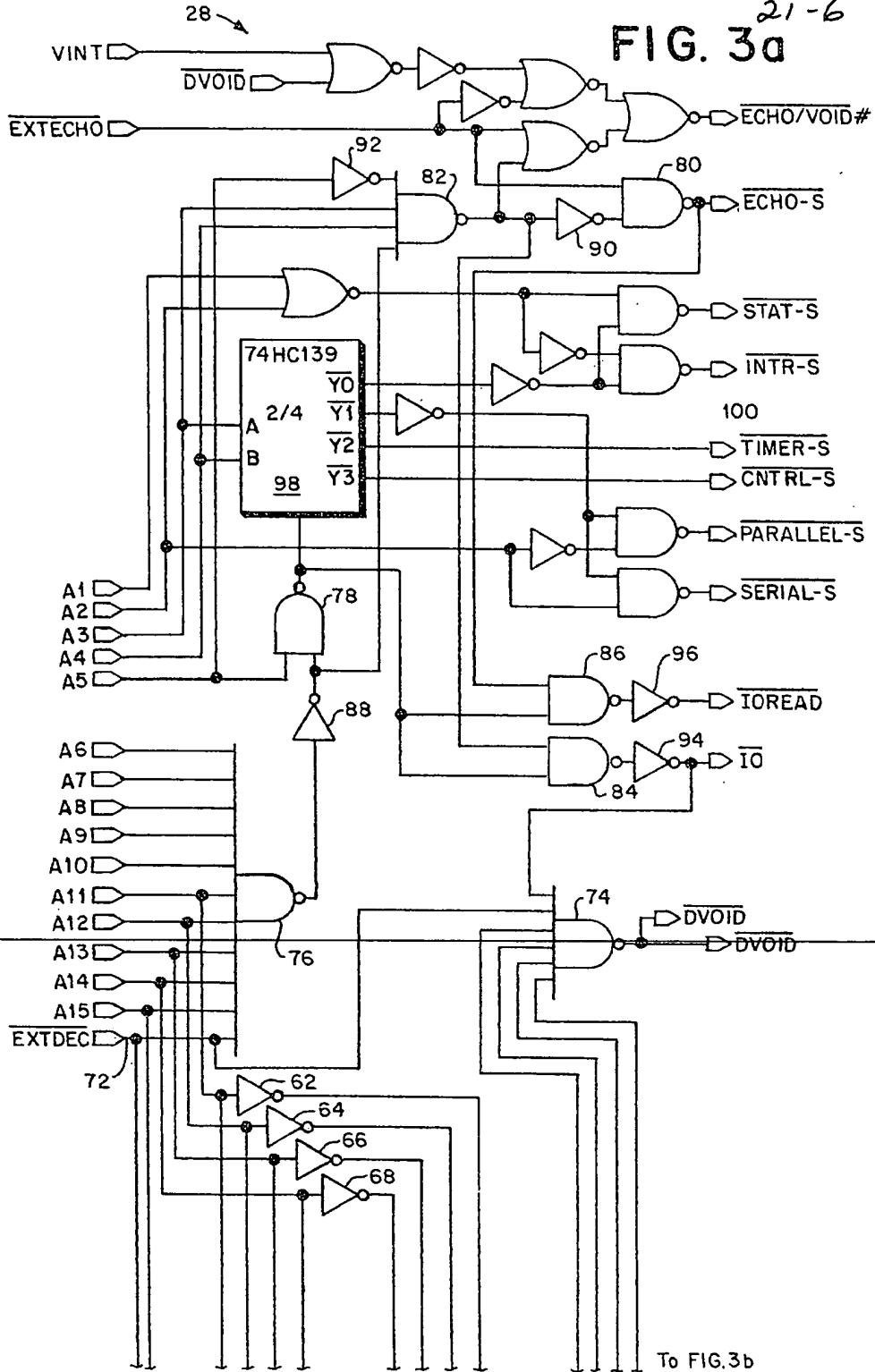


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by [Signature]

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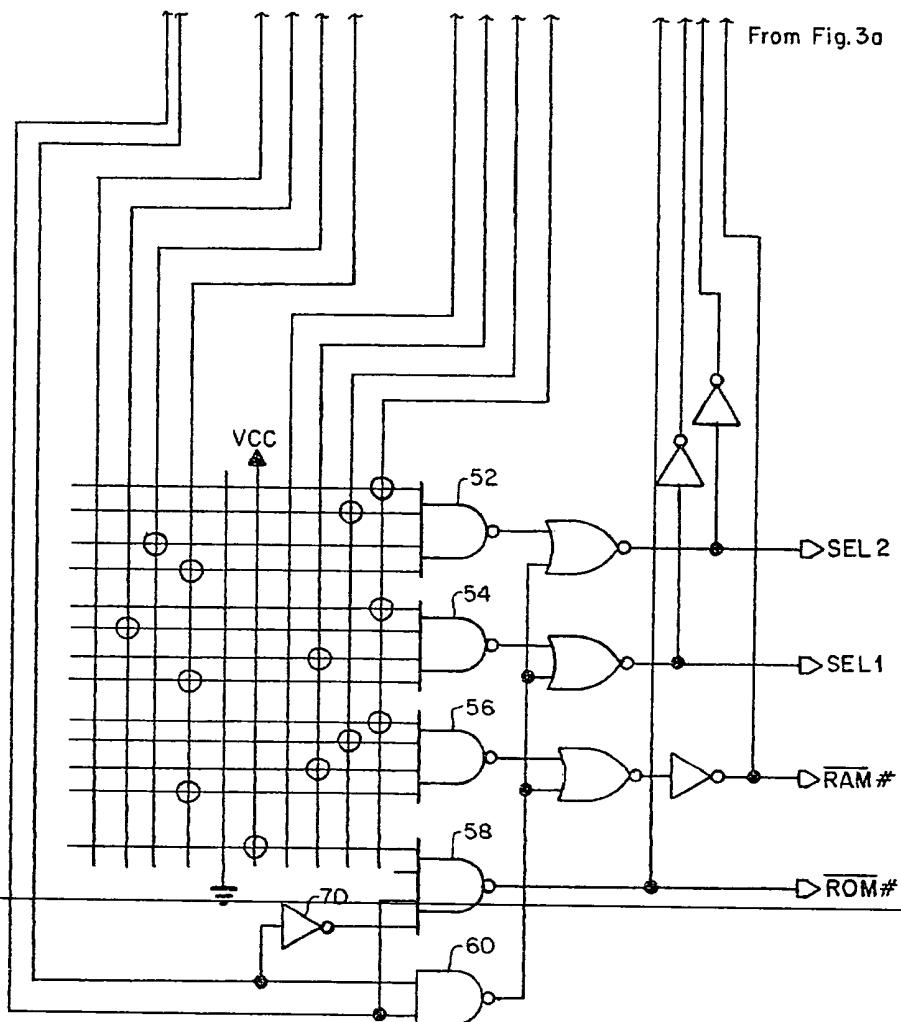
FIG. 3a



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⊕ INDICATES DEFAULT  
METALIZATION CONTACTS

FIG. 3b

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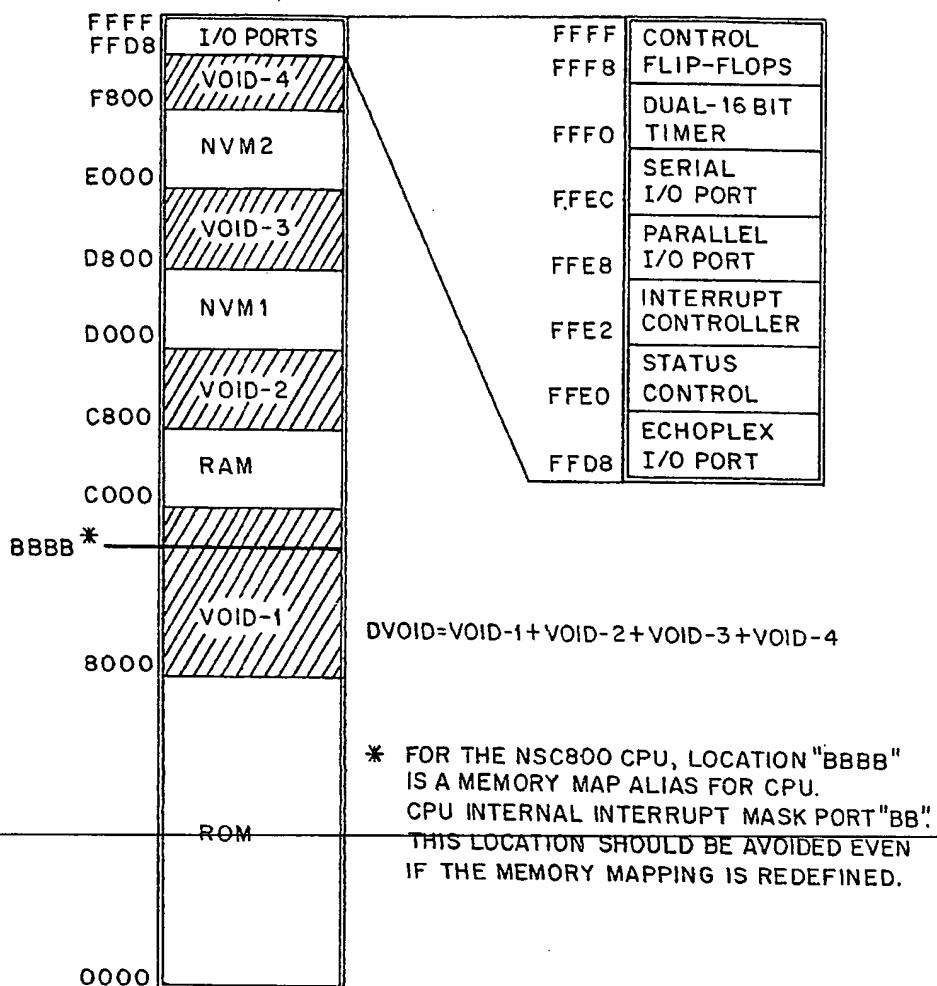


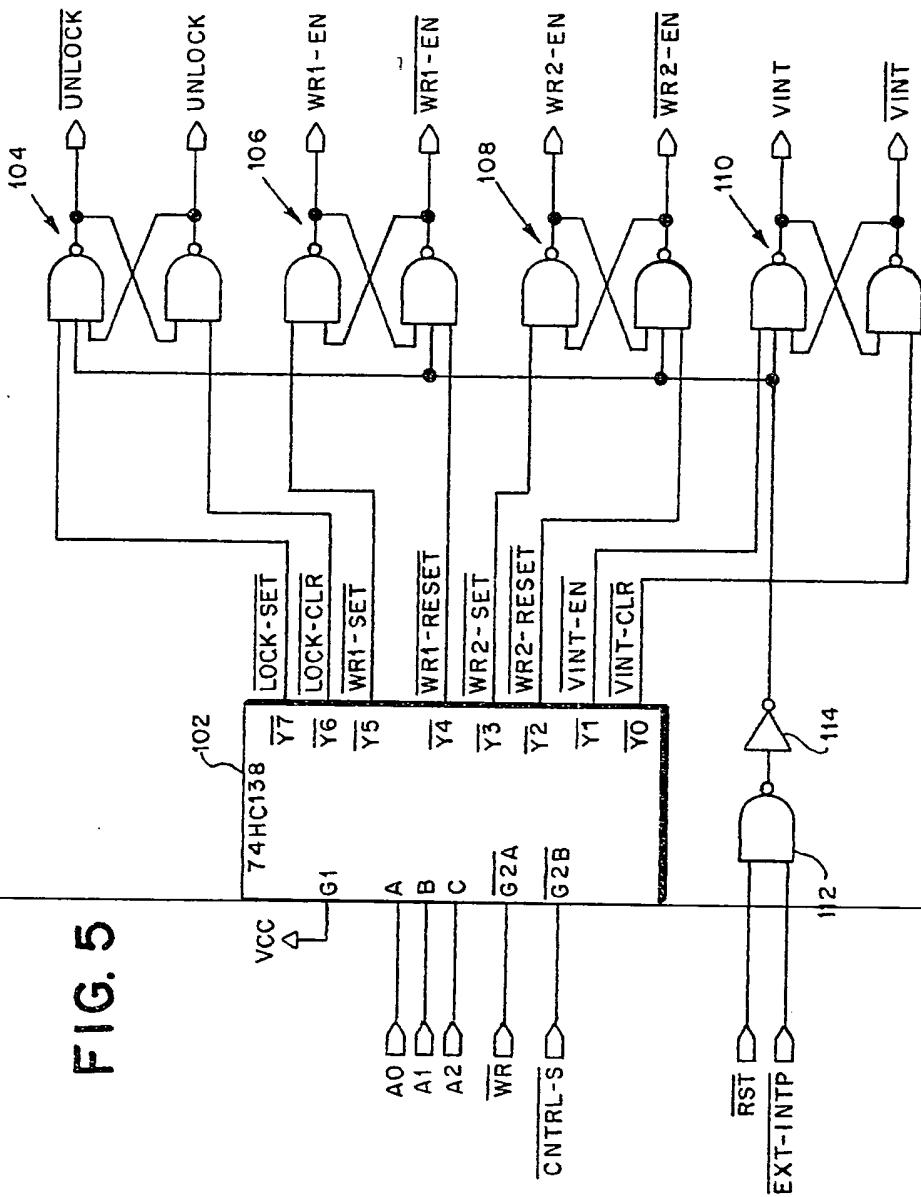
FIG. 4

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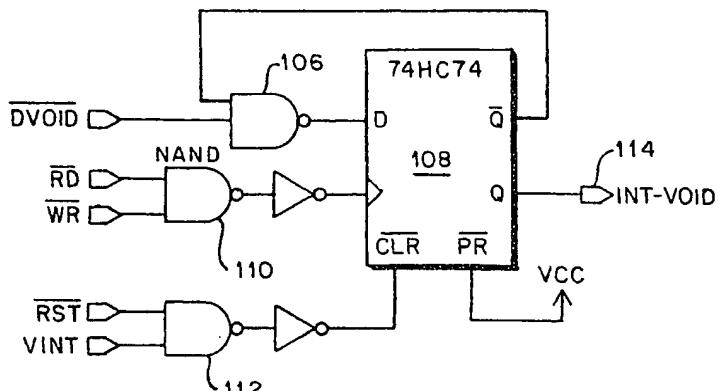
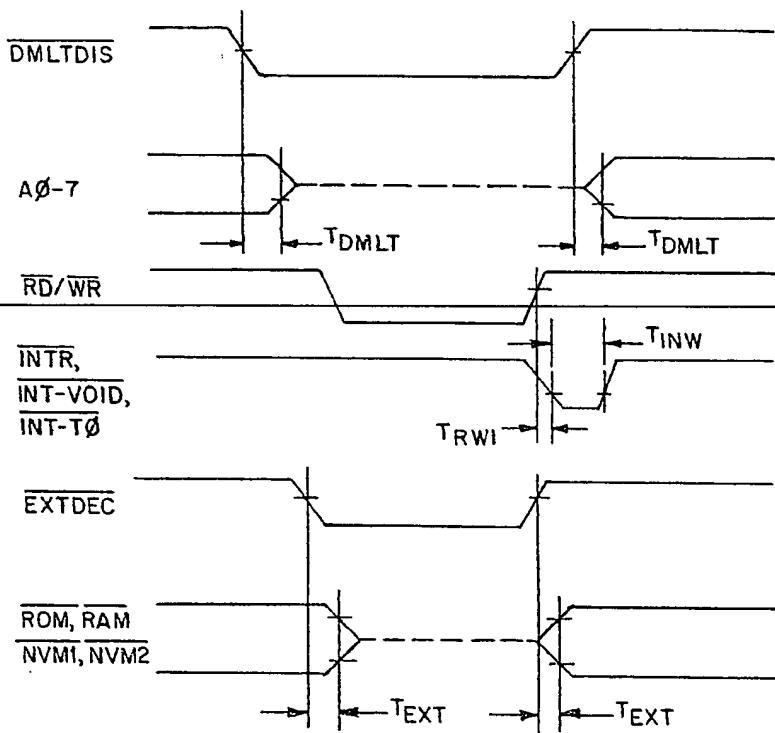


FIG. 6

FIG. 11



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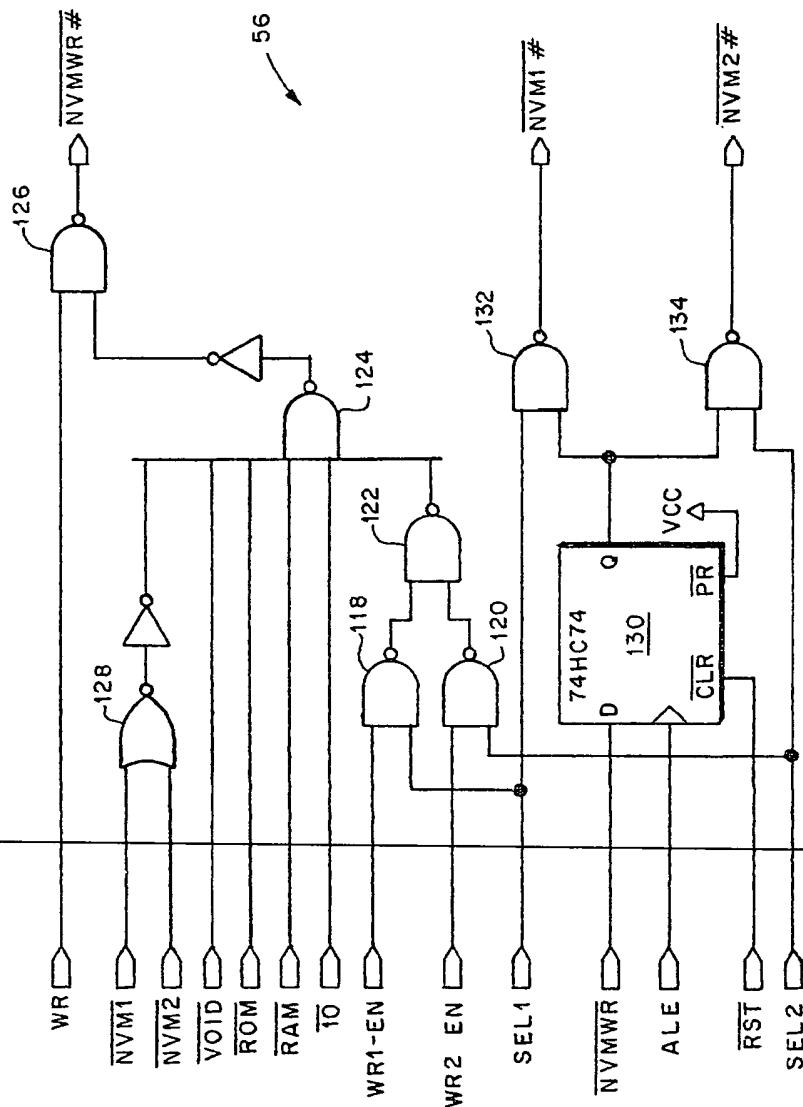
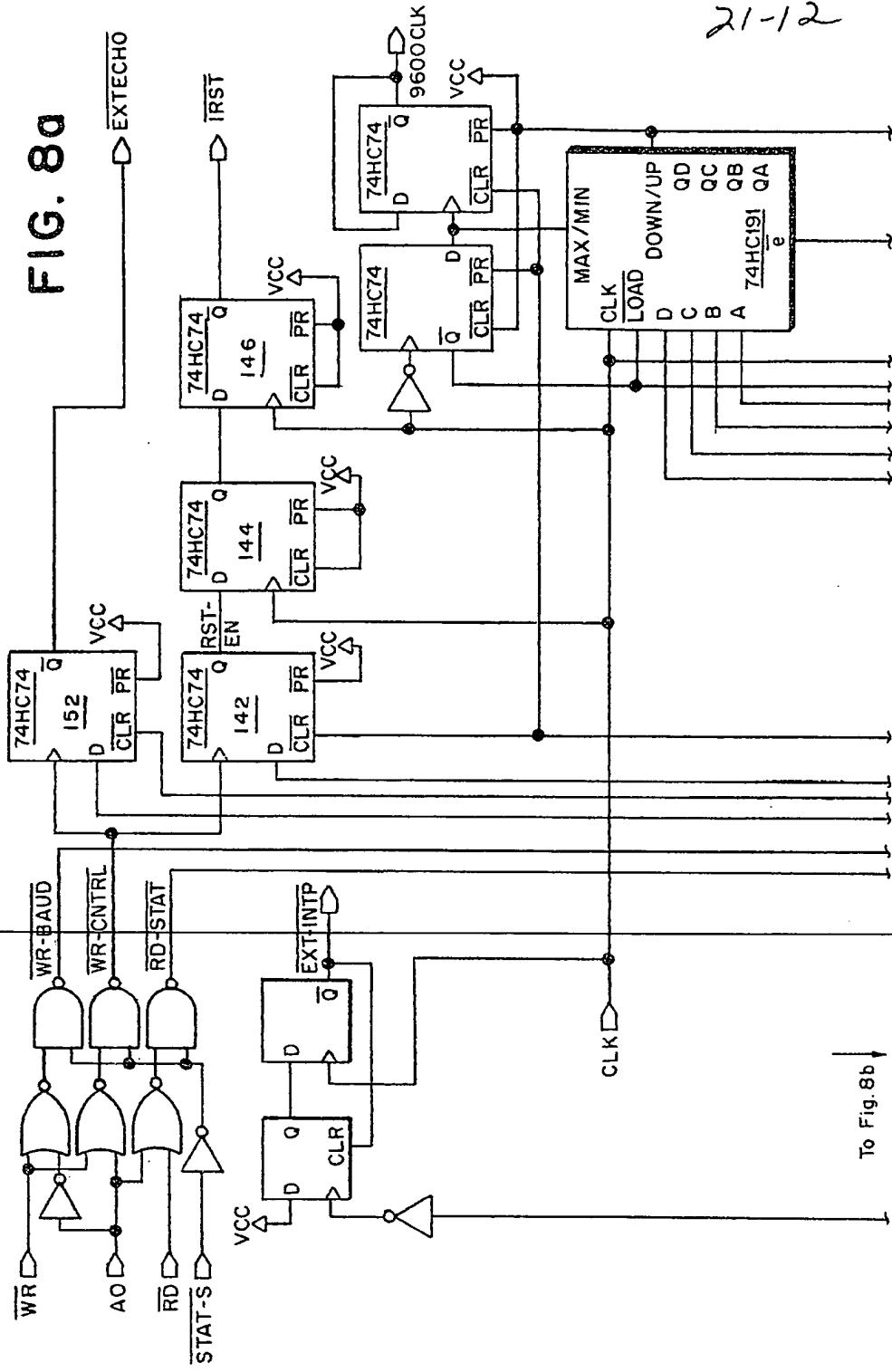


FIG. 7

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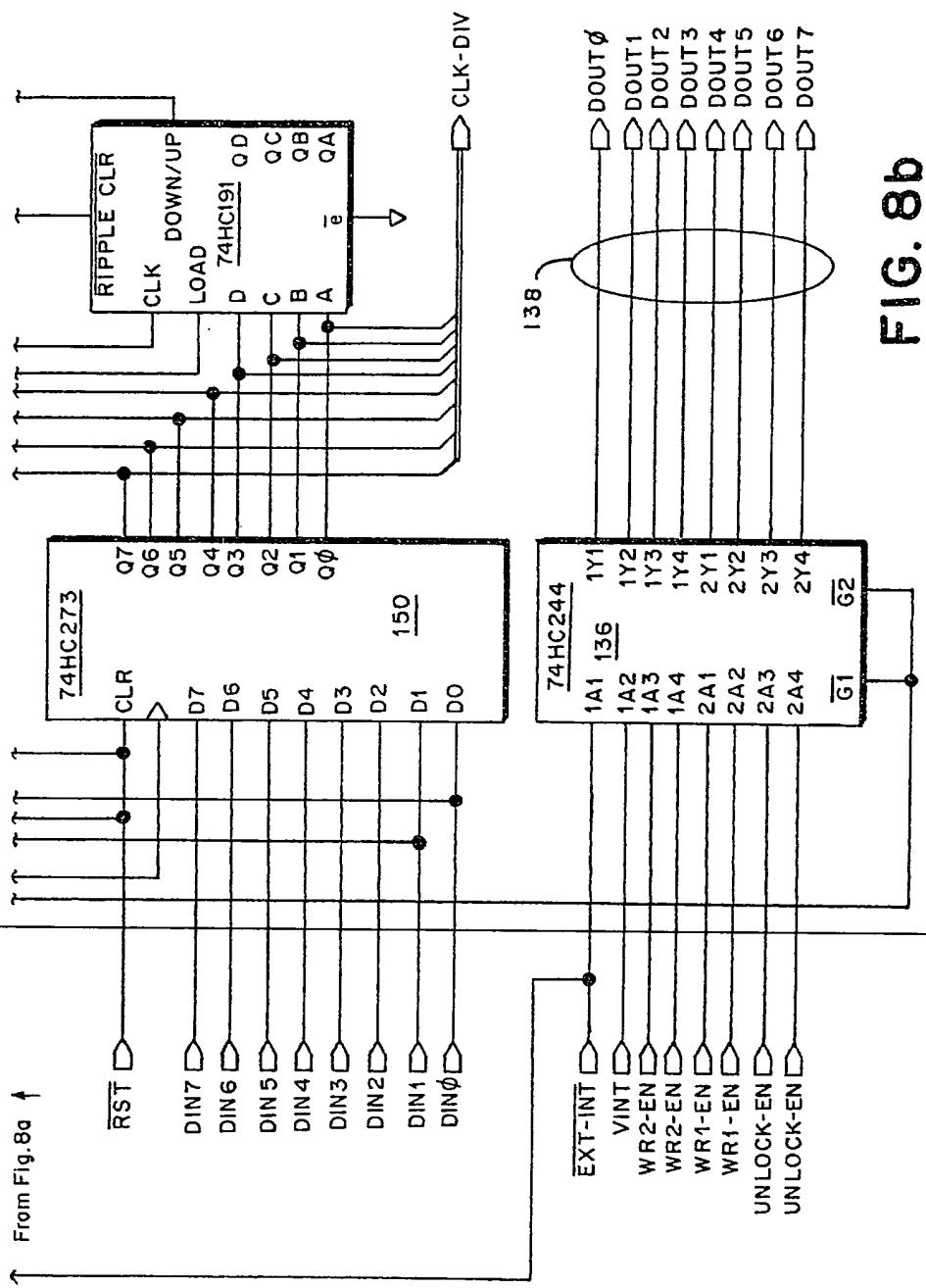
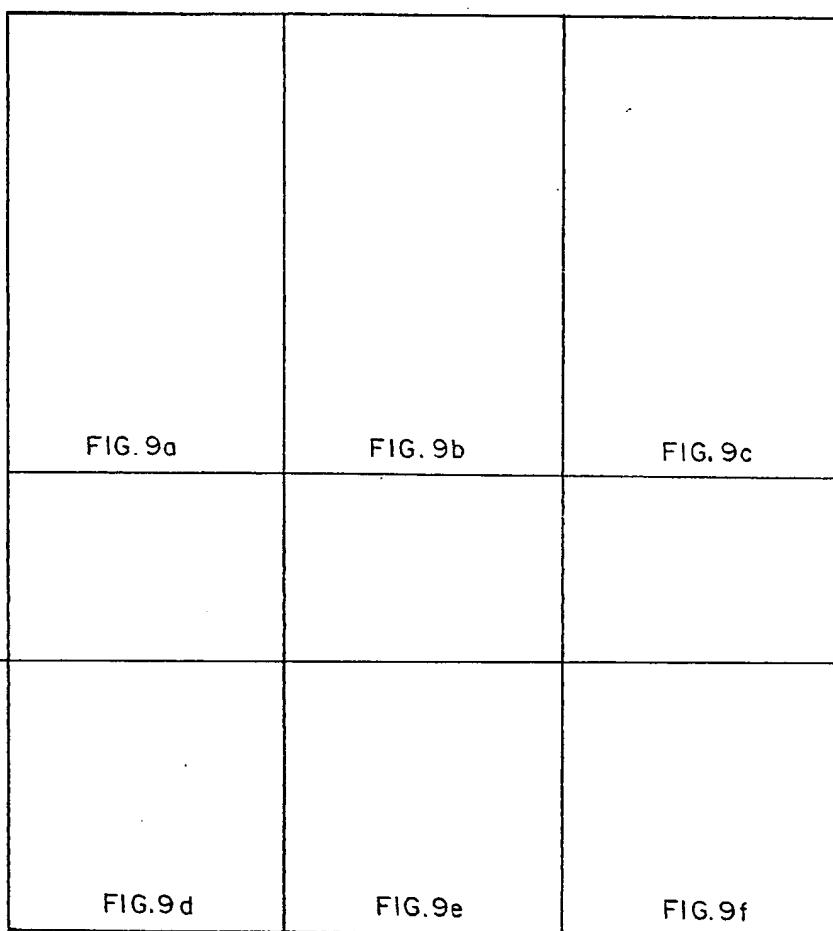


FIG. 8b

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FIG. 9



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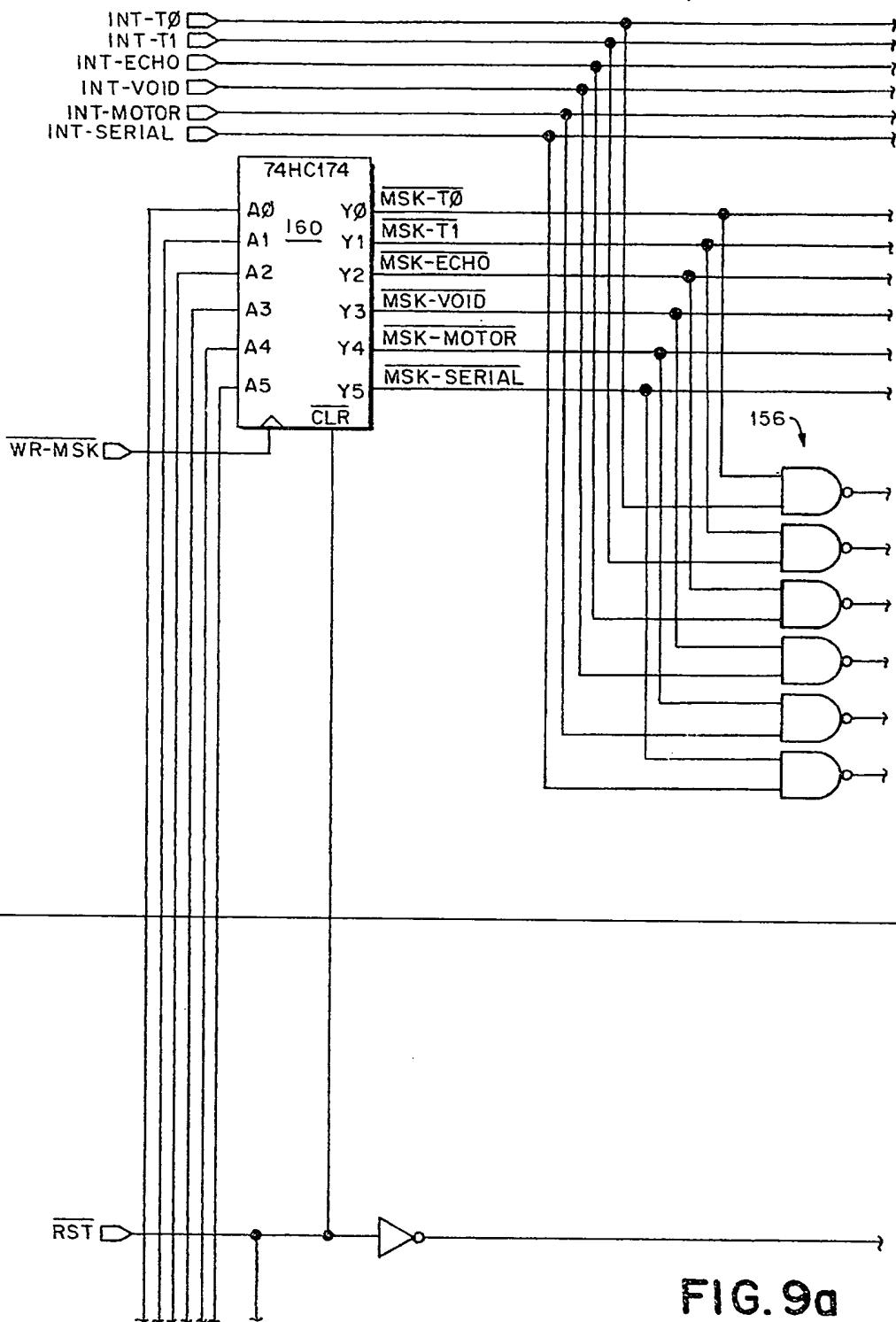


FIG. 9d

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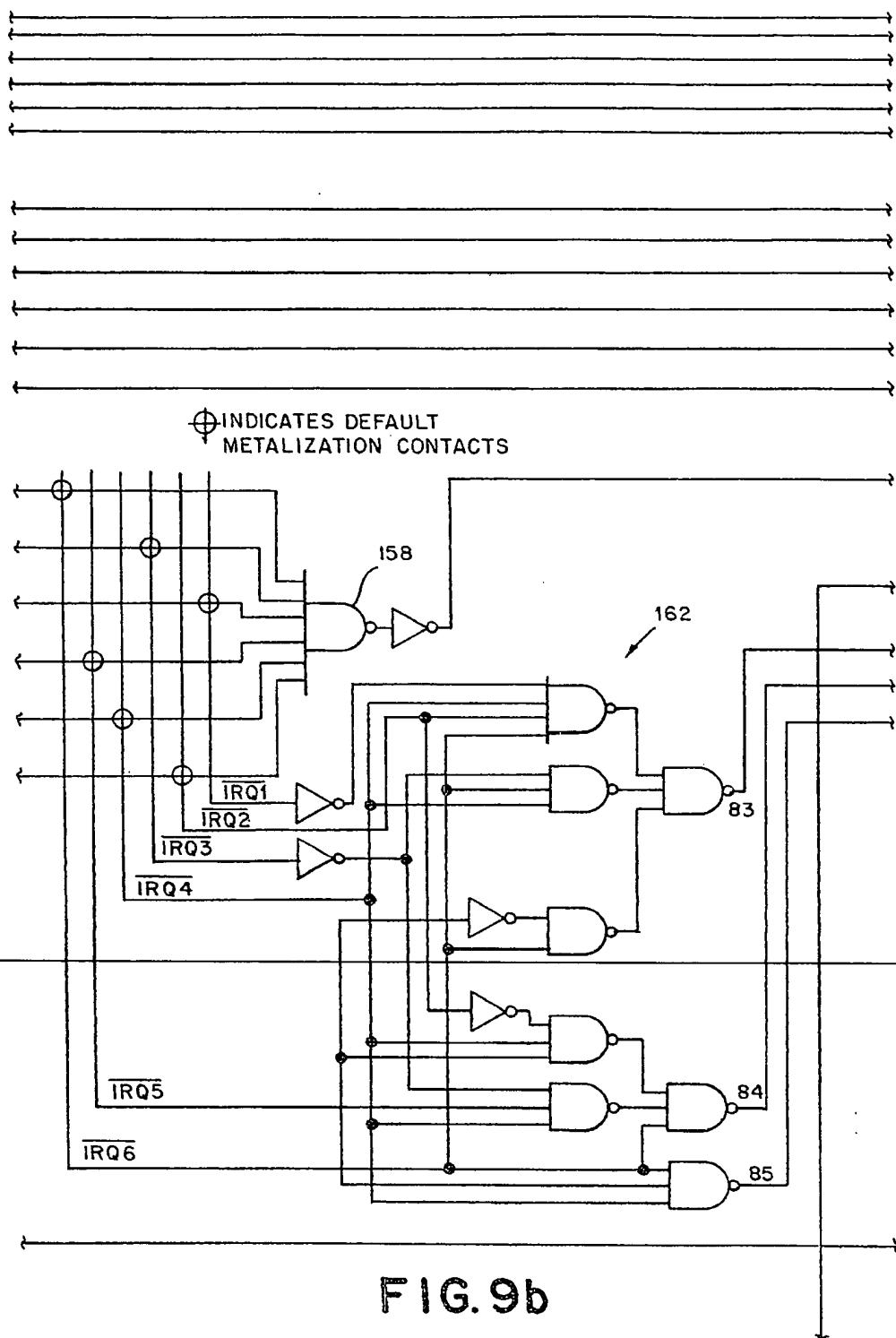


FIG. 9b

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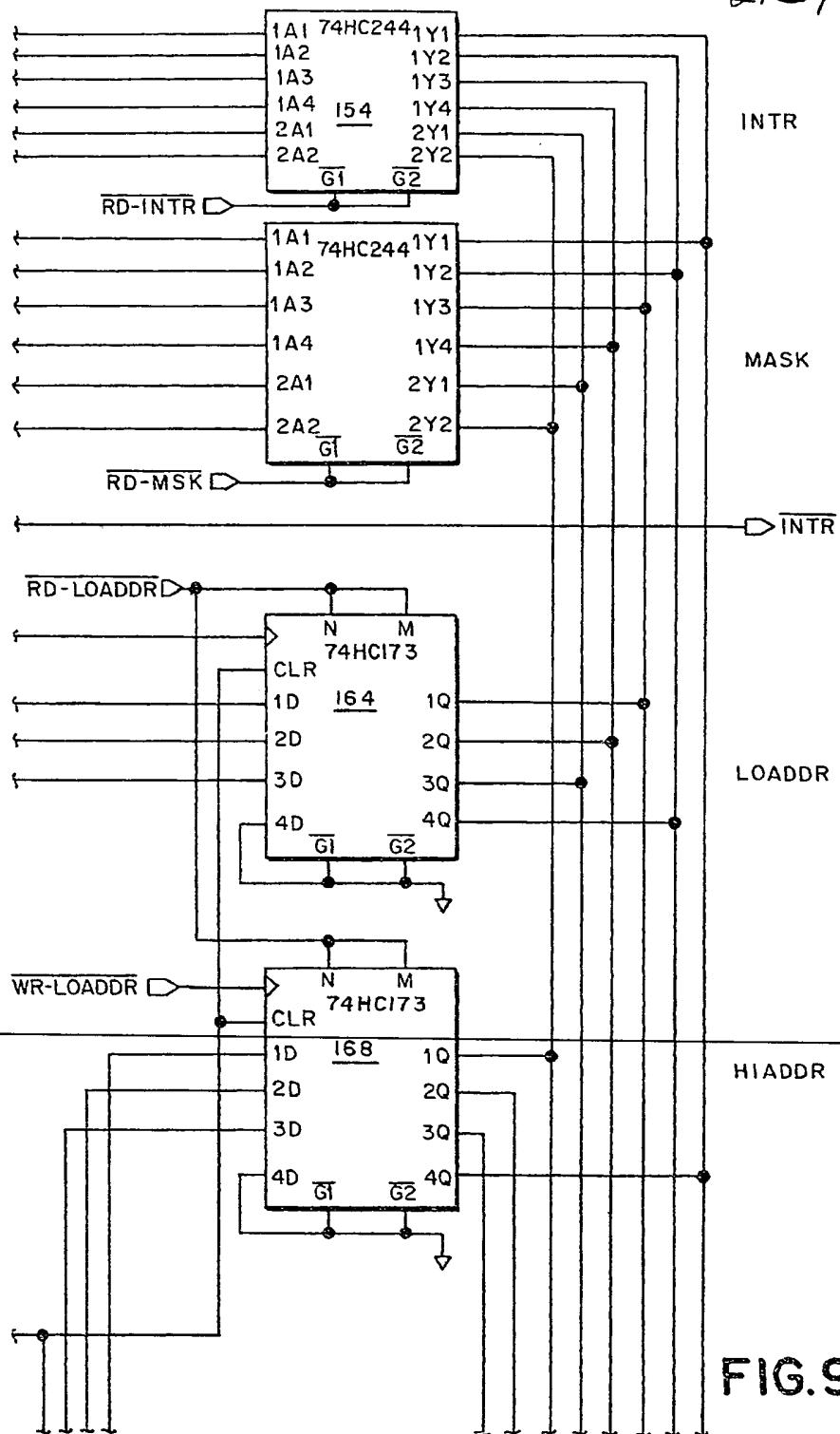


FIG.9c

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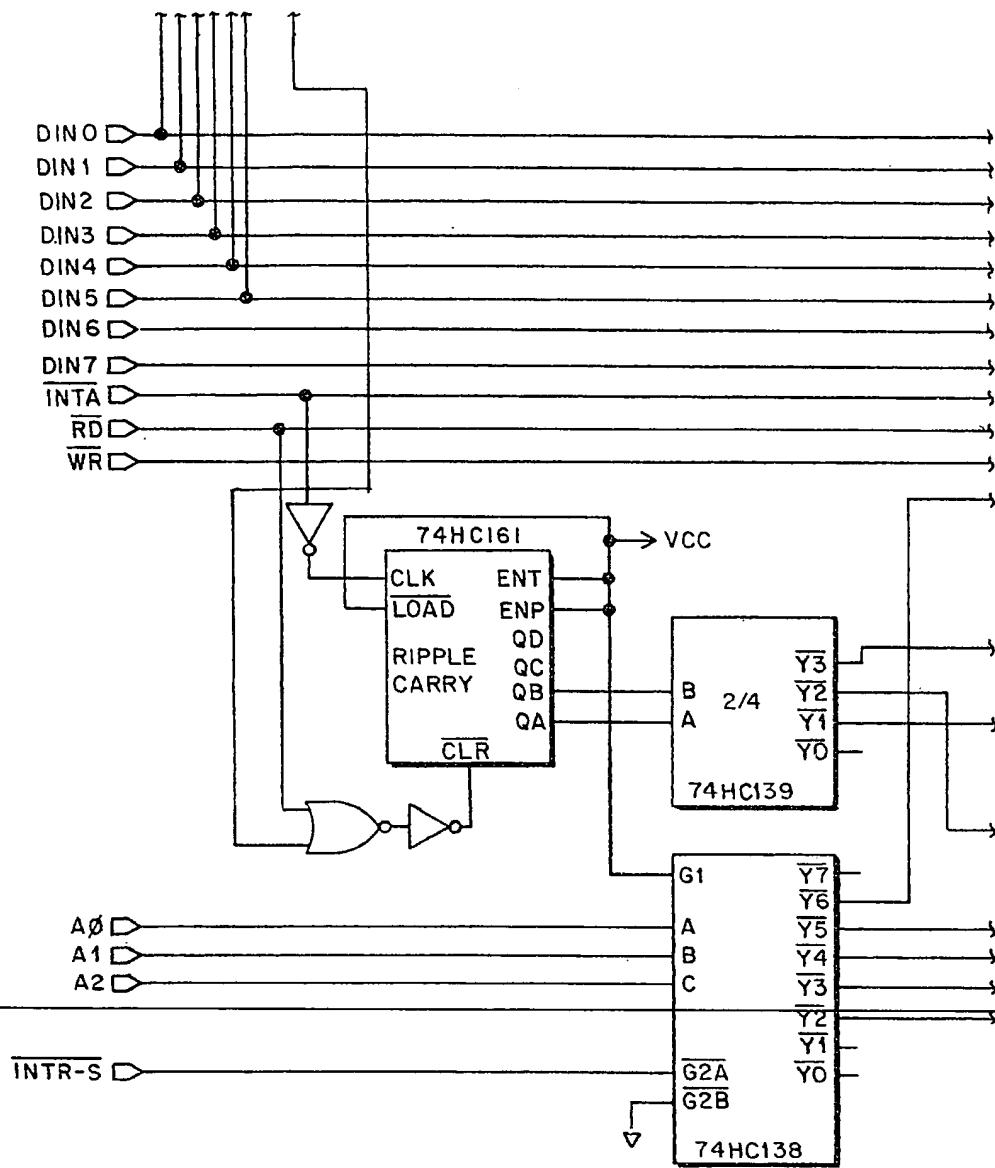
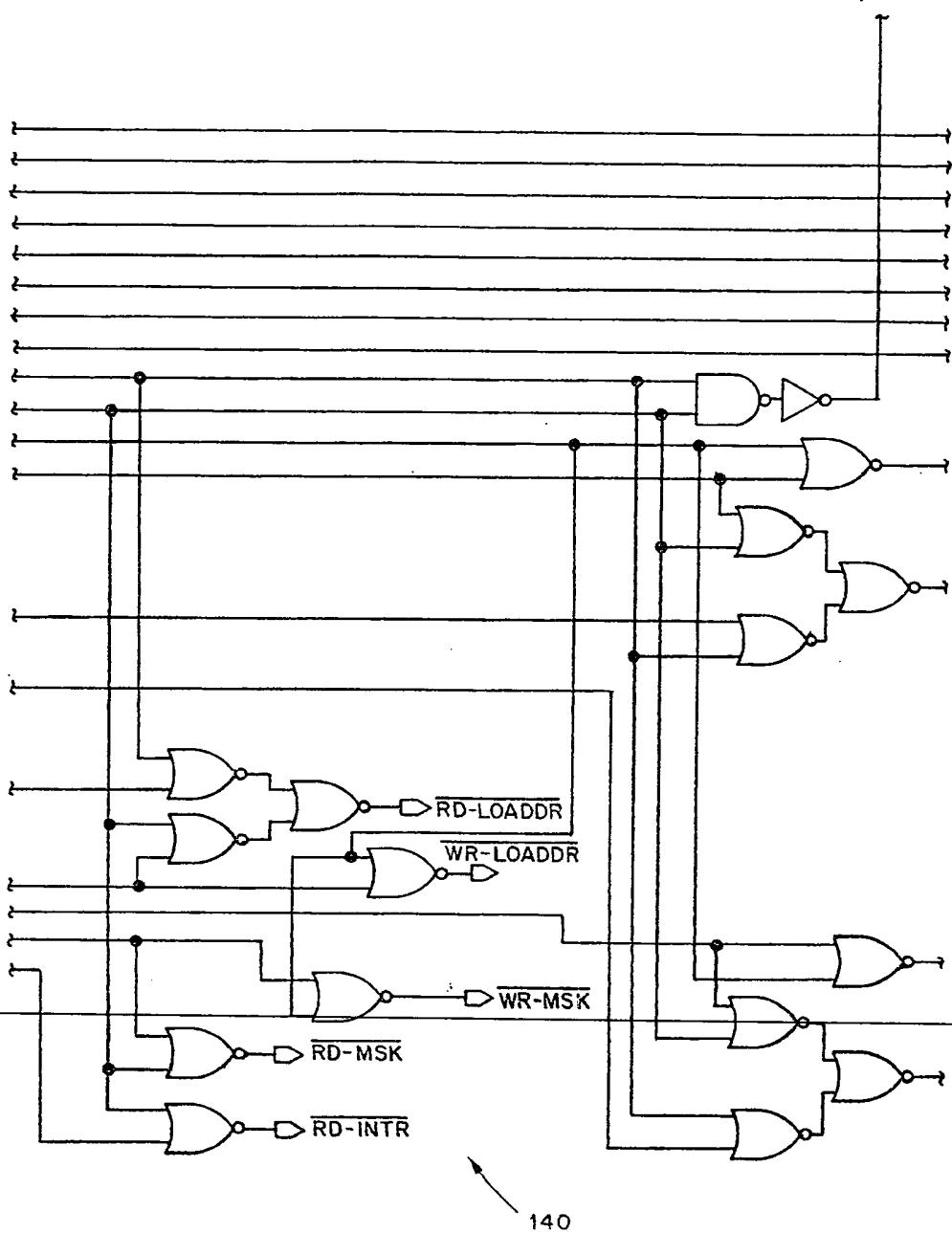


FIG. 9d

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FIG. 9e

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by John Murray

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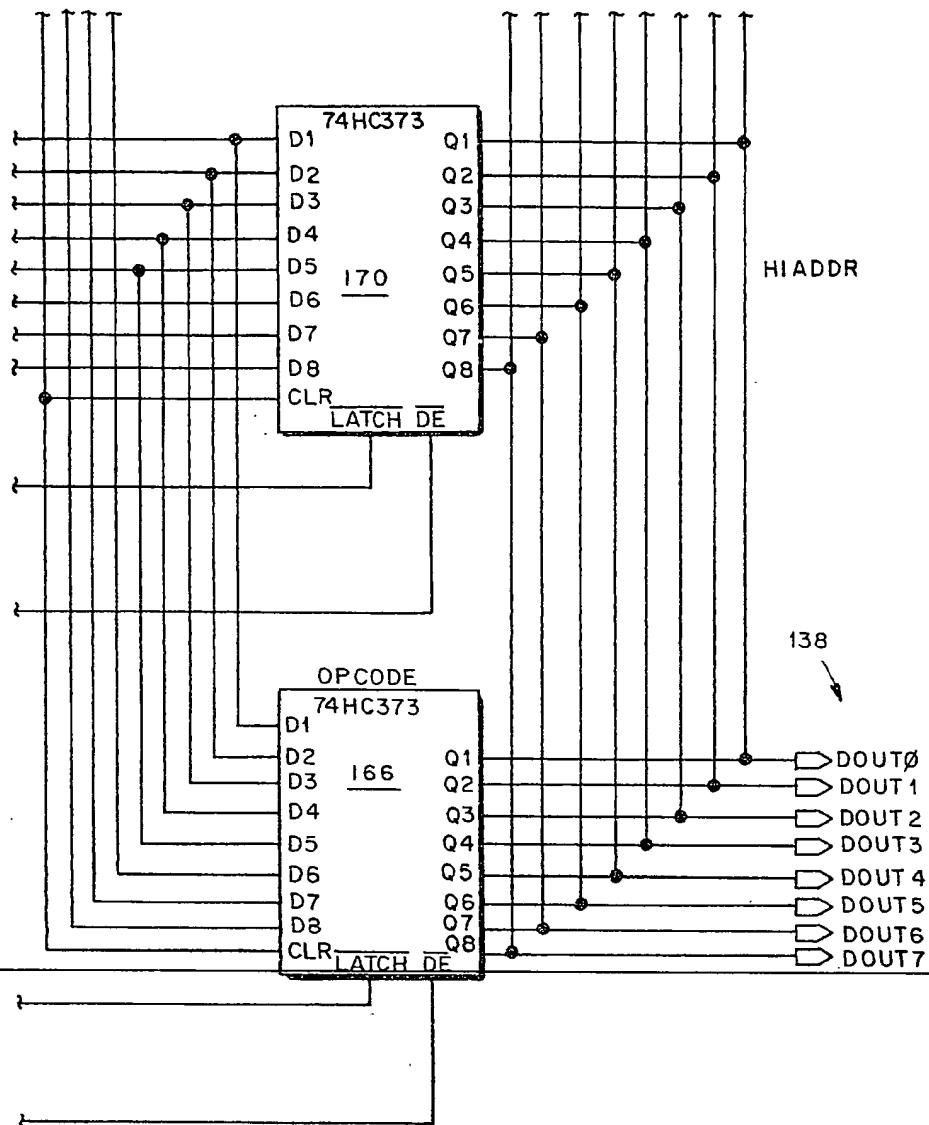


FIG. 9f

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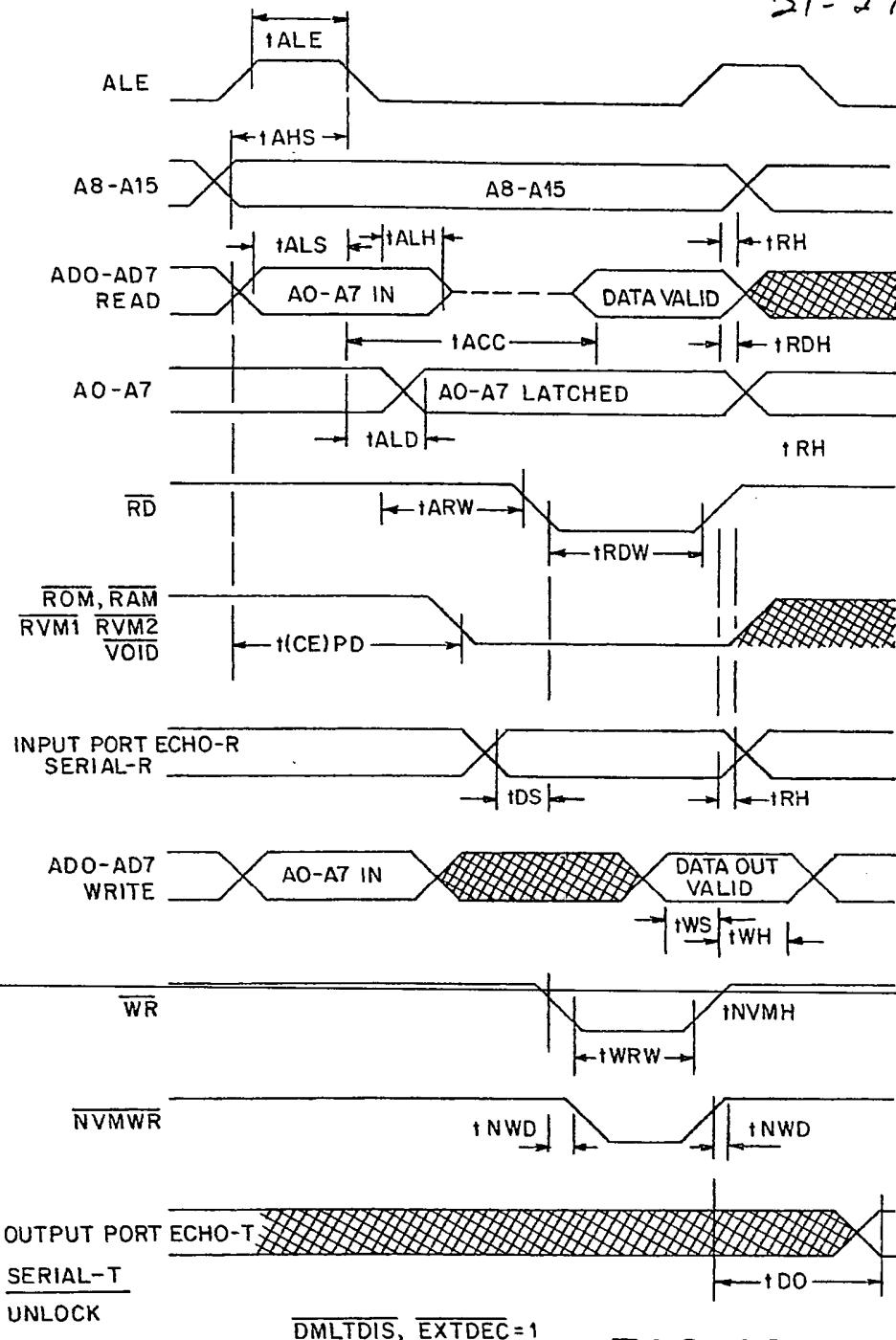


FIG. 10

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